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PHASE I

A REAPPRAISAL OF PREHISTORIC ROADS IN THE SAN JUAN BASIN 1983

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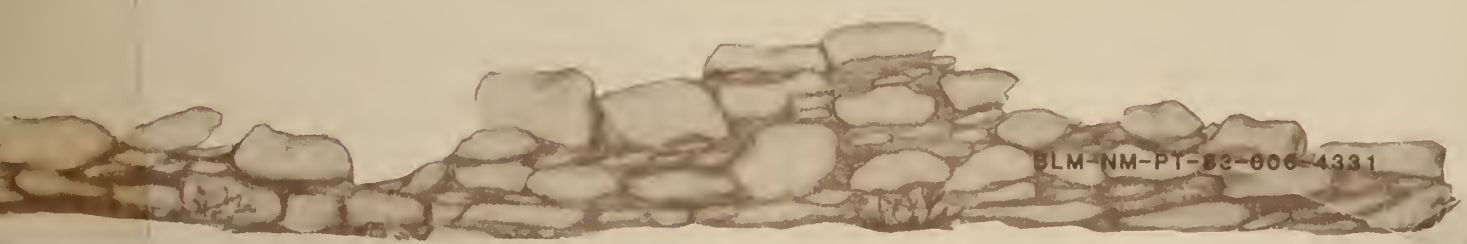

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CHACO ROADS PROJECT
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A REAPPRAISAL OF PREHISTORIC ROADS IN THE SAN JUAN BASIN 1983

CHRIS KINCAID, EDITOR

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Benjamin P. Robertson, John R. Stein, R. Gwinn Vivian

GLOSSARY BY JOHN RONEY

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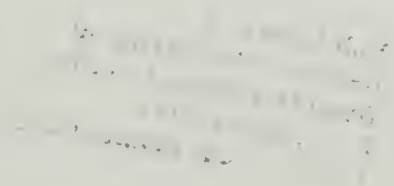

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PREFACE

The history of culture change and development in the San Juan Basin of northwestern New Mexico is long and complex, beginning with the earliest Paleo-Indian occupation more than 12,000 years ago and continuing to the present. This report concerns the documentation of a prehistoric road network associated with the Chacoan Anasazi, a group which existed in the San Juan Basin from the seventh to the thirteenth centuries AD.

The Chaco Roads Project was developed and funded by the Bureau of Land Management (BLM) in response to a wide variety of mangement needs. As a land-managing agency, the BLM is primarily concerned with decisions that are made literally at the ground level. It is frequently in a position of specifying requirements for the protection of surface resources for other public land users and agencies to follow. Initiation of this project was prompted by the recognition of the importance of Chacoan roads, and of the need to develop an effective management program for them in light of widespread existing and proposed surface-disturbing actions in the San Juan Basin.

The study of the prehistoric Chacoan road network is not a new area of scientific inquiry, and work has been done in the past on the nature of roads and their role in Chacoan society. However the BLM, in attempting to devise a strategy for the consideration of Chacoan roads in the context of its land-use policy decisions, found that certain types of useful information were lacking. Although a number of roads had been identified on aerial photography, and a small cluster of roads in and immediately surrounding Chaco Canyon had been ground-truthed, there was very little practical information available on how to locate or study roads in peripheral areas. Road systems were considered potentially extremely significant in the interpretation of Chacoan culture, but the significance and information potential of small isolated road segments was not known. Roads had been identified connecting outlying Bonito Style structures and their communities, but their relationships to simpler architectural forms and material culture scatters remained uncertain. Although roads were visible discontinuously on aerial photographs, whether loci in intervening areas could be consistently located and recorded on the ground had not been demonstrated. In certain areas around Chaco Canyon, evidence suggested that roads had been purposely constructed, but whether or not construction was a common road attribute and whether it could be detected through subsurface observation was not known.

To address these issues, research was directed toward the following goals:

1. A more explicit and consistent system of classification for various aspects of the roads (e.g., types of construction, types of associated sites).

2. An explicit methodology for (a) testing the validity of roads as prehistoric features, (b) identifying roads on the ground, and (c) documenting road segments.

3. A relational structure for understanding the information potential of road-associated sites and features which are not a part of an outlier community.

4. A comprehensive evaluation and integration of past research.

5. A careful evaluation of the issue of road construction, and the development of a methodology to test for and document its existence.

6. An evaluation of the existing aerial photography to (a) identify what factors affect road visibility, and (b) establish specific criteria for distinguishing prehistoric roads from other types of features.

7. An evaluation of the roads data base as it currently exists in aerial photography to determine the probability that imaged alignments are "real," to determine and test the potential for locating new alignments, and to determine the necessity for acquiring additional aerial photography of the roads.

By examining the cultural environment of the roads at the time of their construction, we hoped to learn more about how roads functioned to unify and integrate Chacoan society. By focusing on specific aspects of their physical characteristics, the types of artifacts found in association, the presence of special construction features, and their natural environments, we hoped to gain some new perspectives on the ultimate question, "Why roads?"

The BLM sponsored Phase II of the Chaco Roads Project in the summer of 1982. Unlike Phase I, which was mainly a geographically restricted "intensive" methodological study, Phase II was more "extensive," and focused on the evaluation of widely dispersed road systems thought to exist within areas of the Basin being evaluated for coal extraction. During field work, new information concerning specific road systems and patterns of road-site association was developed which, due to time constraints, cannot be addressed fully in this report. However, a brief summary of Phase II has been included in Chapter 11, and reference to Phase II results have been added to the remainder of the report as appropriate. A full documentation of Phase II is being prepared by the Albuquerque District Office (Nials, Stein and Roney 1983).

A number of people were involved during various phases of this project. The position of Principal Investigator was filled by Ben Robertson from November 1980 until August 1981, and by Chris Kincaid from August 1981 until project completion. Kincaid also

participated in project planning and portions of the analysis and write up, and was reponsible for compilation and editing of the final report. John Stein was in charge of the archaeological field work from August 1981 until project completion, and participated in analysis and write-up of the archaeological information. Daisy Levine was responsible for ceramic analysis in the field, and also assisted in preparation of the final report. David Simons and Denise Galley served as crew members for portions of the field work. Compilation and analysis of aerial photographs was completed by Gretchen Obenauf. Fred Nials, of Eastern New Mexico University, was the geological consultant for the project. He performed the geomorphological evaluation of the study area and specific road segments, the excavation and analysis of trenches, and worked with Obenauf in the photointerpretation of new and existing aerial photography. Gwinn Vivian, of the Arizona State Museum, served as archaeological consultant during the course of field work, and completed the compilation and analysis of previous road studies.

ACKNOWLEDGEMENTS

The completion of this project represents the combined efforts of many individuals who were involved in various stages of project planning, fieldwork, analysis and reporting. The authors wish to express their gratitude to those individuals who willingly gave their time and encouragement to our efforts.

Various line managers in the Bureau of Land Management provided the administrative and financial backing so essential to a project of this scope and duration. Specifically, Larry Woodard, Bill Luscher, Marv LeNoue, Gene Schloemer, Paul Applegate, Mat Millenbach and Bob Caulkins of BLM New Mexico State, District and Resource Area Offices, authorized and jointly supported this effort. To them go sincere gratitude for seeing this project through to its completion, and for making a commitment to the sound management of cultural resources in the state of New Mexico.

Special thanks are also due to various individuals within the Bureau who assisted in seeing that the project actually materialized. Marie Larragoite, coal program leader, was a mainstay of support and assistance. Leo Flynn and Fran Levine participated in the early stages of project planning. Don Boyer assisted in the initial editing, Jim Jones and Joe Morphin administered contracts and other procurement actions, and Lee Bryan, Penni Mahon and Jeff Nighbert assisted in overseeing final report production.

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The Laboratory of Anthropology in Santa Fe provided valuable assistance in the storage and analysis of our data. Tim Seaman worked tirelessly in developing computerized formats for analysis of material culture. Stew Peckham assisted in ceramic classification, and Marsha Jackson and Rosemary Talley helped in numerous additional ways.

A number of individuals gave freely of their own time to assist in various aspects of field work. The excavation of Bis'a'ani Ruin, sponsored by the Navajo Tribe, was in progress concurrently with our project, providing an excellent opportunity to exchange ideas and expertise. Our thanks are extended to Cory Breternitz, Mike Marshall, Doug Dykeman, Marcia Donaldson, Dabney Ford and others for their good company and input on the roads issue. Cory Breternitz, Mike Marshall, Dabney Ford, Bill Kight, and Rich Loose also assisted extensively in reconnaissance and site documentation, and generously shared their own expertise on the Chacoan Anasazi. Alan Kosse provided consultation on soil stratigraphy and classification. Fred York, Chuck Griffin and Martin Begay enlightened us on the significance of the roads to the Navajo. Marilyn Swift and Penny Whitton guided the crew to a potential road-associated community near Pueblo Pintado.

Thanks also to the Huerfano, White Horse, Pintado, Crownpoint, Lake Valley and Nageezi Chapters of the Navajo Tribe, and to the many Navajo people who must have been curious about the crew of Anglos wandering across the landscape but never interfered.

The task of producing the final report was shared by many. Typing (and retyping) was completed by Penni Mahon, Irene Rivera, Mary Esther Sanchez, Liz Vargas, Guadalupe Martinez and Doris Herrera. Many thanks for a tedious job cheerfully done. Drafting of the numerous line drawings and figures was completed by Myrna Finke, Joy Rivera, Dave Wunker, and Ralph Leon. Cover layout and chapter tabs were designed by Myrna Finke. Again, your patience and the quality of your work are greatly appreciated.

Tony Lutonsky assumed the task of overseeing the selection and printing of photographs, and of selecting final formats for all graphic illustrations in the report. John Roney developed the glossary, while Gretchen Obenauf edited and complied the bibliography. The job of assembling the final report was supervised by Penni Mahon. To these individuals, who made a personal commitment to the quality of this document, we express our sincere gratitude.

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Daisy Levine
Fred Nials
Gretchen Obenauf
John Stein
Ben Robertson
Gwinn Vivian.

ABSTRACT

Prehistoric Chacoan roads possess many morphological traits common to formalized prehistoric road systems recognized in other areas of the New World. Their width, straightness, and association with features at elevated locations are all consistent with systems recognized in other complex societies in Central and South America.

Most previous field research on Chacoan roads has focused on roads recognized in and around Chaco Canyon. These studies have collected information concerning the relationship of roads to major ruins within the Canyon, and a high degree of formalization has been recognized for some roads near Pueblo Alto, Pueblo Bonito and Penasco Blanco. In addition, a number of previous theoretical studies have incorporated the presumed road network into systemic interpretations of the relationship between the central Canyon and dispersed contemporaneous communities on the periphery of the Basin. Most recent models infer a transport function for the roads, and interpret them as part of a hierarchical redistributive network connecting zones of varying productivity.

The current project attempted to utilize the results of previous research as well as new techniques to develop a consistent methodology for the study of roads. Emphasis was placed on developing techniques allowing identification of roads from both the aerial and ground perspective, on defining the information potential of roads and associated sites and features, and on integrating site-specific analyses into a theoretical framework which encourages the interpretation of a road system as a functional entity.

Results of photointerpretation and ground studies to date suggest that only a fraction of the full extent of the road system is currently recognized. Acquisition of new, project-specific photography is strongly recommended for future studies. These photos should be taken utilizing techniques to maximize road visibility as demonstrated in photos taken for this project.

It is necessary to understand the factors affecting visibility of prehistoric roads before strategies can be developed to maximize it. Natural aspects of the past and present road environment as well as cultural factors relating to road construction and use affect road visibility. Specific criteria can be utilized in both photo and ground observations to increase the accuracy of road identification.

The physical characteristics of roads observed on the surface and in trench profiles should be carefully recorded. This information is useful in assessing the degree of preservation of the road, the information potential of individual road segments, as well as the nature and degree of construction of the road. Quantitative and qualitative analyses of non-cultural surface materials in and adjacent to roads, combined with detailed examination of substrate variability and stratification, can potentially provide strong evidence for construction.

In many respects fieldwork strategies for the archaeological inventory of prehistoric roads resemble conventional inventory methodologies. However, a number of special techniques were developed to enhance recognition of the alignment, involving the use of aerial photography, specialized recording formats, careful attention to the location of the real or projected alignment, and selective use of different survey intensities. Specialized expertise is a requisite for the field crew, due to unique problems in field recognition and recording. Because ceramic scatters often provide the only evidence of the location of the road alignment, a strict no-collection policy is recommended except where surface disturbance of the road is imminent.

Both intensive and reconnaissance surveys were performed on selected portions of the North, Penasco Blanco to Ahshislepah and South Road systems for this project. Intensive survey involved 100 percent coverage of a one-quarter mile wide survey corridor defined by the imaged or projected road alignment. Evidence accumulated from these surveys allowed the generation of recommendations concerning road verification, and interpretation of the cultural environment of the survey area prior to, during and subsequent to road construction and use.

Evidence allowing road verification includes the increased abundance of Anasazi materials near the prehistoric alignment, and patterning in the location, physical characteristics or material culture of sites thought to be road-associated. Information collected during this project allows verification of the North, Penasco Blanco to Ahshislepah and South Road alignments as prehistoric features.

A management plan for the roads addresses the key stages of inventory, evaluation and mitigation. Inventory methodology requires careful planning and integration of a number of kinds of information, including photo-interpretation, geological and botanical evaluations, and archaeological records search. The level of inventory must be responsive to management needs and the desired goals of the project. The significance of a road segment or associated site depends mainly on its potential for contributing to important issues in roads research, on the presence or absence of unique physical characteristics, and on the socio-cultural importance to the Native American community. Decisions concerning appropriate mitigation measures are based on the significance of the site, but data recovery is considered a feasible mitigation approach in most instances.

CHAPTER 1

CHAPTER 1

PROJECT DESCRIPTION

The BLM is charged with administering a diverse set of programs related to energy and other developments on public lands while at the same time ensuring adequate protection for other important resources which may be located on these lands. Recent widespread energy development in the San Juan Basin has defined a critical situation where resource conflicts are severe, and which requires balanced, informed management decisions.

The primary goal of the Chaco Roads Project was to establish criteria to test the existence and validity of prehistoric roads, and to collect sufficient information for the development of a comprehensive prehistoric roads management program if they were, in fact, proven to exist. Information needs for this management program are diverse and complex due to the nature of the resource and the type and extent of current and planned developments throughout the San Juan Basin.

Management Situation

Planned Projects

The BLM is responsible for the management of approximately 1.9 million acres of public land and mineral resources in the San Juan Basin; currently under consideration are a number of separate but interrelated proposals for major actions within this area. These proposals concern the following projects: Coal Preference Right Lease Applications (PRLAs), San Juan River Regional Coal Leasing (SJRRCL), Wilderness Study Areas (WSAs), Ute Mountain Land Exchange, New Mexico Generating Station (NMGS), Bisti Coal Lease Exchange, and the Continental Divide Pipeline.

Environmental Impact Statements (EISs) are currently being prepared or planned for four of these proposed actions (NMGS, SJRRCL, WSAs, and Continental Divide Pipeline). Less extensive studies (Environmental Assessments) are being prepared for the remaining actions. In addition, a companion document is being prepared addressing the cumulative impacts of all of these projects (with the exception of the Continental Divide Pipeline) which is known as the Cumulative Overview Document.

Two types of coal leasing actions are currently being studied by the BLM. Applications for Preference Right Leases were accepted by the Bureau prior to the passage of the Federal Coal Leasing Amendments Act of 1976 on the basis of applicant demonstration of workable coal deposits. Issuance of a Preference Right Lease is nondiscretionary and noncompetitive under these circumstances, pending verification of the commercial viability of the coal deposits and the satisfaction of other specific conditions. Approximately 75,500 acres of public, Indian, state and private lands underlain by federal coal are currently under application for Preference Right Leases.

Competitive coal leases are the second primary component of the federal coal program in the San Juan Basin. The decision to consider further some Basin lands for competitive coal development was made through the land-use planning process for the Chaco/San Juan Planning Units completed in September 1981. The results are summarized in a booklet titled "Coal Development Planning," available from the BLM Albuquerque District Office. Delineation of these lands into commercially viable tracts has been done as part of the coal program activity planning. This includes approximately 3.52 billion tons of coal (proposed from both competitive and PRLA acreage) to be considered available for lease in 1983.

The three designated Wilderness Study Areas (WSAs) in the San Juan Basin lie near the area containing the majority of the PRLAs as well as the proposed generating station site. The Bureau will propose that the 3,968-acre Bisti WSA and the 19,922-acre Denazin WSA be designated as wilderness areas, and that the 6,536-acre Ahshislepah WSA not be designated.

Paragon Resources, a subsidiary of the Public Service Company of New Mexico has offered 17,134 acres of private land on Ute Mountain near Taos, New Mexico in exchange for up to 7,780 acres of public land within the San Juan Basin. An environmental analysis of this action has been completed. The acquired land is to be used for the construction of the New Mexico Generating Station and related facilities, as well as for a possible new townsite.

The New Mexico Generating Station is currently planned for an area near the Bisti WSA, approximately 35 miles south of Farmington. This would be a 2,000 megawatt coal-fired facility, utilizing coal extracted from the local area. Associated actions include the construction of approximately 40 miles of water pipeline system to supply water from the San Juan River/Navajo Reservoir area, and approximately 100 miles of 500 kV transmission line to deliver power to various load centers near Albuquerque.

The Bisti Coal Lease Exchange is an action mandated by Congress under Public Law 96-475 involving the substitution of coal reserves elsewhere in the San Juan Basin for lands currently under coal lease in the Bisti WSA. An as yet undetermined number of acres will be selected from a 3,763-acre exchange pool, equal in commercial value to the coal reserves currently held in approximately 1,261 acres of leased lands in the Bisti. An Environmental Assessment is currently being prepared by the Albuquerque District Office of the BLM.

A right-of-way application for the Continental Divide Pipeline has been filed by the Continental Divide Pipeline Company.

This proposed pipeline would extend from the Colorado border near Farmington across the San Juan Basin to near Grants, New Mexico crossing Chacra Mesa near Pueblo Pintado. Suggested alternative routes to date include a western route along the Chuska Mountain foothills following Highway 666, and a central route which parallels the existing El Paso gasline.

The preceding enumeration includes only those pending large projects for which BLM holds a major share of the responsibility for study or authorization. Many additional projects which are not mentioned here are being planned or implemented by other agencies and affect only a small acreage of public land. In addition, numerous oil and gas fields are currently active or in operation, and many small permits, rights-of-way and land-use applications for these and other actions are processed each year by the Bureau in the San Juan Basin. Finally, the San Juan Basin is known to contain large reserves of uranium. When market conditions improve, additional development of these resources is expected.

BLM Cultural Resource Management

In an effort to assure adequate consideration of cultural resource values in the course of administering large land-disturbing projects the Bureau has undertaken a number of actions and programs. In the Chaco/San Juan Planning Unit land-use plan coal update, a number of specific decisions were made for the protection of Native American religious areas, special cultural resource study areas, Areas of Critical Environmental Concern (ACECs) containing especially sensitive cultural resource values, the Azabache Stage Station, as well as a number of federally-owned Chacoan outliers. Also included were specific recommendations pertaining to the protection of prehistoric Chacoan roads.

Three major sample inventories (Class II) have recently been completed by the Bureau in the San Juan Basin for the purpose of defining overall patterns of site density and distribution and guiding general land-use allocation decisions. Two of these inventories, the Bisti-Star Lake Class II Phase I (Huse, Noisat and Halasi 1978) and the Bisti-Star Lake Class II Phase II (Kemrer 1982) were centered in the PRLA area directly north of Chaco Canyon. A third survey, the Chaco South Inventory (Dulaney and Dosh 1981), was completed for the area south of Chaco Canyon, roughly to I-40. The results of these surveys have been used as the basis for initial Section 106 consultation for major projects in compliance with the National Historic Preservation Act, and for initial sensitivity assessment.

In 1979, Congress gave recognition to the outstanding importance of Chacoan cultural remains by passing Public Law 96-550, Title V. This legislation expanded and renamed what was then Chaco Canyon National Monument, and designated 33 Chacoan outliers as Archaeological Protection Sites. In addition it charged Department of Interior agencies to develop a special program for the protection and management of these sites, and to evaluate new sites for inclusion in the list. The mandated plan for Archaeological Protection Site management (known as the Joint Management Plan) was recently completed and circulated for public review. The BLM has participated in the development of the Joint Management Plan, and will continue to cooperate with the National Park Service, the Bureau of Indian Affairs, the State Historic Preservation Officer and various other federal and state agencies to assure protection for these important resources.

Prior to the passage of PL 96-550, the Bureau was operating under a cultural resource activity plan prepared specifically for Chacoan outliers in federal surface or subsurface ownership. This Interim Management Plan contained recommendations for protection measures including protective fencing, patrol and surveillance, and stabilization, as well as for the development of visitor-use facilities at selected sites.

The Chaco Roads Project was initiated by the Bureau as a special study, in recognition of the fact that because of difficulties in identifying these resources they were not apt to be successfully addressed in the environmental assessment process. Their affiliation with the Bonito Phase of Chacoan prehistory gave them special significance, and their presumed role in the integration of the Chacoan system suggested that they might provide information critical to the interpretation of the entire Chacoan culture. The special study was warranted by the lack of information concerning procedures for identifying and evaluating the prehistoric roads data base, coupled with the threat of imminent destruction of large portions of the roads without appropriate management and protection policies.

Project Implementation

Determination of Data Collection Priorities

The principal goal of the project was to collect sufficient information to enable the BLM to manage prehistoric roads as a cultural resource. As a result of this management perspective, certain objectives were emphasized; primary among these was the development of a workable methodology for the location, verification and recording of roads on the ground. It was imperative that the procedures developed be easily understood by the professional community, not overly expensive, replicable and as accurate as possible.

As a means of accomplishing these basic objectives, a Research Design (Robertson 1981) was prepared and circulated for peer review, in which a set of data collection priorities was developed for use during the

field phase. The design was based on a broad geographical area, and addressed two main goals: the development of a "recognition pattern" for roads from the aerial and ground perspectives, and the interpretation of roads in the context of Chacoan culture history.

After initiation of field investigations, however, established data priorities were reassessed. The process of locating and recording roads had proved to be extremely complex, and it was necessary to use a variety of techniques, and information from a variety of disciplines, to identify them on the ground. This dictated an intensive, detailed approach to the recording process. The additional time required for this intensive approach ultimately caused a substantial reduction of the number of miles which could be inventoried. This reduction seriously limited our ability to address the second stated goal, the interpretation of how roads functioned in the Chacoan system. It was determined that of the two goals, the development of an explicit methodology for ground recognition and recording was more critical to proper management, and should therefore take precedence. The extensive approach which would have aided consideration of broader interpretive issues was thereafter deemphasized in project implementation.

During this reevaluation of priorities, it was necessary to carefully assess what information was needed for the development of appropriate management policies. It was determined that three basic types of information would be required: methods for the location, verification and recording of roads (Inventory Plan), a set of criteria for establishing the significance of different road segments, and standard procedures for evaluating preservation and data recovery options in the context of proposed surface-disturbing projects (Mitigation Plan). Research questions from the original research design were then screened and assigned a priority based on their applicability to these management objectives. These questions determined the data collection priorities which were followed during the remainder of the fieldwork. A more detailed statement of management and research objectives follows.

Inventory Plan. One of the most basic management requirements is that the spatial distribution of the resource in question be thoroughly understood so that resource conflicts can be identified. (While methods and procedures for inventorying other types of cultural resources are fairly standardized and widely recognized, no such guidelines were available for work on linear features such as prehistoric roads.) Generally, an inventory plan has a number of different parts, including these:

1. Records Search - Definition of relevant background data.

2. Level of Inventory - Description of different degrees of intensity of fieldwork for varying management needs.

3. Fieldwork Guidelines - Procedures for physically locating the resource on the ground.

4. Recording Format - Format for recording variability in resource characteristics.

5. Files Storage - Procedures for the accumulation of a consistent data base to facilitate future analysis.

In order to develop each of these parts, it was necessary to address the following research questions:

1. What factors affect the visibility of roads, from both the aerial and ground perspectives?

2. What are the physical characteristics of roads, both surface and subsurface?

3. How do sites associate with roads? Are there observable patterns in spatial arrangement, physical characteristics, chronology or function of road-associated sites?

4. How can prehistoric roads be distinguished from historic roads and other types of cultural and natural features?

5. How can aerial photography be used most effectively to further roads research?

6. What types of variability in the cultural and natural environment of the roads are important to record?

Significance Assessment. Another important role of management is to assess the significance of a particular resource, and establish the distinction between what is, and is not, "highly significant." Criteria for significance thought to be relevant to the roads data base included the following:

1. Relative Scarcity - How many similar resources are there?

2. Interpretive Potential - Is this resource amenable to visitor interpretation?

3. Ethnic Values - Is this resource significant or important to Native American groups?

4. Information Potential - Can this resource be used to further the understanding of history or prehistory?

Recognizing these management needs, research was directed towards the following questions:

1. What is the potential of roads and road-associated sites for contributing to our understanding of Chacoan prehistory?

2. Which road segments contain the most scientific information concerning road characteristics or cultural affiliations?

3. What is the extent of the Chacoan road system?

4. Are prehistoric Chacoan roads recognized by contemporary Native American groups?

Mitigation of Impacts. A third major role of management is to determine appropriate mitigation measures in those situations where a resource will be impacted. To a large degree this depends on the significance of the resource, and its sensitivity to various types of impacts. The following are the standard mitigation options employed for other types of cultural resources:

1. In Situ Preservation (Avoidance) - Avoidance is normally achieved through project relocation, redesign, or cancellation.

2. Detailed Recording - After an initial inventory, the site may be revisited to record additional detailed data, generally through surface observation.

3. Data Recovery - Generally refers to the collection of additional data, either by surface collection, subsurface testing, or full excavation, prior to site destruction.

The following research problems were related to these general goals:

1. What types of roads or road-associated sites should be preserved?

2. What are the most efficient and effective detailed recording and data recovery strategies?

Project Implementation

The field phase of this project involved a number of different types of data collection activities controlled along three major dimensions. The first dimension was the observation perspective; three perspectives were utilized: aerial observation, surface observation, and subsurface observation. The second dimension was the general type of variability, whether of cultural or natural origin; both were considered essential to meet project goals. Third was the cultural context of the observations, whether they were "road-related" or "site-related"; again, both types were controlled for.

All possible combinations of these dimensions of observations were evaluated during the course of the project, using either new or existing information, as shown in Figure 1-1.

Orientation of Data Collection Activities

I. Aerial Observation
   A. Roads Data
      Natural Variability
      Cultural Variability
   B. Site Data
      Natural Variability
      Cultural Variability

II. Surface Observation
   A. Roads Data
      Natural Variability
      Cultural Variability
   B. Site Data
      Natural Variability
      Cultural Variability

III. Subsurface Observation
   A. Roads Data
      Natural Variability
      Cultural Variability
   B. Site Data
      Natural Variability
      Cultural Variability

Figure 1-1

The complexity of the data recording procedure for this project can be readily understood if the reader considers that the visibility of road segments varies with the observation perspective; recognition of different types of cultural and natural variability at all levels of observation requires a variety of recording strategies and a mix of professional expertise; and the validity of any particular road system or segment can be evaluated only after all types of data are integrated.

Work began with the photointerpretation of SCS 1930s and BLM 1973 aerial photography for a number of road systems. Archaeological inventory was then performed at the reconnaissance level for several of these systems; later, more intensive inventory and recording took place on portions of the North Road, the Penasco Blanco to Ahshislepah Road,

TABLE 1-1

STRUCTURE OF DATA COLLECTION AND ANALYSIS ACTIVITIES

Observation Perspective	Data Format	Person in Charge	Data Collection Activities	Chapter Reference
Aerial Observation - Roads Data				
Natural Variability	Aerial Photo Overlays	Nials	Aerial Photointerpretation	5-Factors Affecting Visibility
Cultural Variability	Aerial Photos, Photointerpretation Record	Obenauf	Aerial Photointerpretation	4-Evaluation of Aerial Photography
Site Data				
Natural Variability	Aerial Photo Overlays	Nials	Aerial Photointerpretation	5-Factors Affecting Visibility
Cultural Variability	Aerial Photos, Photointerpretation Record	Obenauf	Aerial Photointerpretation	4-Evaluation of Aerial Photography
Surface Observation - Roads Data				
Natural Variability	Visible Segment Form	Nials	Consultant Reconnaissance	5-Factors Affecting Visibility
Cultural Variability	Existing Data, Visible Segment Form, Site Forms, Narrative Summaries	Stein, Vivian	Records Search, Cultural Resource Inventory	3-Historical Perspective 8-Road Analysis 9-Verification Summary Appendices A and C
Site Data				
Natural Variability	Site Form	Stein	Cultural Resource Inventory	8-Road Analysis
Cultural Variability	Existing Data, Site Form	Stein, Vivian	Records Search, Cultural Resource Inventory	3-Historical Perspective 8-Road Analysis 9-Verification Summary Appendices A and C
Subsurface Observation - Roads Data				
Natural Variability	Trench Profiles, Notes	Nials	Subsurface Trenching	6-Physical Characteristics
Cultural Variability	Trench Notes	Nials	Subsurface Trenching	6-Physical Characteristics
Site Data				
Natural Variability	Records from Previous Work	Nials	Data Synthesis	6-Physical Characteristics
Cultural Variability	Records from Previous Work	Nials, Vivian	Data Synthesis	3-Historical Perspective 6-Physical Characteristics Appendix A

and the South Road. A professional geomorphologist conducted geological evaluations of a number of areas and specific sites along several roads, and performed more intensive studies involving subsurface trenches and surface rock counts in 12 and 3 locations respectively. Simultaneously, background studies were conducted to compile information concerning previous roads research both on Chacoan road systems, and on other road and trail systems in prehistoric New World cultures.

Table 1-1 shows the relationship between these various information collection activities, the personnel involved, and the chapters of this report in which they are discussed. The analysis of collected information addressed pertinent research issues, requiring the integration of data from several different observational perspectives. A major area of inquiry was the issue of road visibility; the cultural and natural factors which might be causing differential visibility, and methods which might be used to enhance visibility from the aerial, surface and subsurface perspective were studied. Several discussions are focused on the related issue of road construction, how to detect its presence and what the implications are for labor investment in road systems. Another major analytical emphasis was the question of how the utilization of the prehistoric roads is or is not reflected in sites which are presumed to be "road-associated." A number of different types of evidence pertaining to this issue are explored (including spatial relationships, physical site characteristics, and material culture traits).

Chapter Summary

The Chaco Roads Project was initiated to fill a management need for information concerning this complex and intriguing resource. This need has been generated by numerous planned surface-disturbing projects, many of them energy related, which are to be implemented in the San Juan Basin in the coming years. Management needs included procedures for testing the validity of roads as prehistoric features, systematic methods for their inventory, criteria for assigning significance, and criteria for data recovery and preservation policies. Field implementation of this project involved a diversity of data collection activities. Results were analyzed to address several key interpretive issues, including factors affecting visibility of the roads, evidence for road construction, and road-site association.

CHAPTER 2

CHAPTER 2

OTHER NEW WORLD ROADS AND TRAILS

In order to evaluate the attributes of Chacoan roads it is necessary to be aware of how they compare to their functional and morphological counterparts in other prehistoric cultural systems. This chapter therefore contains a brief review of other road and trail systems in the New World. A comparison of this sort helps establish expectations about the amount of preservation we can expect in Chacoan roads and suggests factors which may influence preservation and visibility of roads and trails in different cultural and environmental contexts. In addition, it provides a perspective for evaluating associated sites and features, and suggests possible methods of observation and recordation. Such a comparison can help define functional parameters that might be applicable to routes of foot and animal travel given the level of prehistoric technology, and it can illustrate how other systems have been formalized. Finally, comparison of prehistoric roads can suggest interpretations of roads and trails and define how they functioned in exchange and interaction systems.

Research on road and trail systems is hampered by the limited amount of information available. This problem appears to have two principal causes. The first of these is a failure on the part of ethnographers, historians and archaeologists to recognize the importance of the topic. The problem is summarized by Davis in his work on trade routes in California:

"The lack of coverage of these topics possibly reflects a series of conscious or unconscious assumptions on the part of both informants and ethnographers. For example, it would not be unreasonable to suppose that if one San Franciscan informed another that he was going to Oakland, both parties would probably assume that the route followed would be over the San Francisco-Oakland Bay Bridge. Similarly, an Achomawi informant, for example, might offer the information that 'we go to Glass Mountain to get obsidian', and unless further information is elicited by the interrogator as to the route traversed in getting there, such intelligence probably would not be volunteered because the Indian, possibly unconsciously, assumes that anyone knows how to get to Glass Mountain..." (Davis 1961:1).

The second difficulty is that even if writers described the routes taken by prehistoric trails or roads, they most often did not indicate what the actual physical attributes of the road or trail were. This problem occurred in virtually all areas. One gains the impression from the literature that the only important features of a trail are its point of origin and destination, since everyone obviously knows what a trail looks like. In some cases, like that of the eastern United States, the only information available comes from research done in the late nineteenth and early twentieth centuries based on historical accounts rather than field observations.

This summary is in no way intended to be exhaustive. The nature of the literature on this subject precludes any truly systematic approach because the information is limited largely to occasional brief comments on early trails in a variety of types of documents. It is recognized that there may be other potentially valuable references on the subject.

California

The prehistoric trail systems in California have been better documented than most other prehistoric roads or trails in the western United States (Farmer 1935, Sample 1950, Johnson and Johnson 1957, Hindes 1959, Davis 1961, Rogers 1966). Sample points out that trails have been discovered in all areas of California:

"Myriads of Indian trails crisscrossed each other in the valleys of California. Early travelers were often confused by the multitude of choices; they needed and used Indian guides to show the correct paths" (Sample 1950:1).

Sample goes on to provide a useful general description of the trails:

"The trails in the sierra regions followed natural passes. Many trails were wide and worn a couple feet deep from long use. They could be traced long after the Indians had gone and the paths were abandoned. They seem to have gone in straight lines--the shortest route to the destination--without detouring for mountains in the way. Stephen Powers says in speaking of the Wailaki that time and again he wondered why trails went over the highest part of the mountains. He finally decided that the elevated points provided lookout-stations for observing the movements of enemies....Trails were marked in various ways....Sometimes piles of twigs or cairns of stone along a trail have been called markers. Powers says that branches and twigs piled at the junction of Yurok trails sometimes accumulated in heaps several feet high. Every Indian passing deposited a twig on the pile" (Sample 1950:2).

With respect to the course of the trails, Barrett and Gifford make the following observation: "Miwok trails were usually almost airline in their directness, running up hill and down dale without zigzags or detours" (Barrett and Gifford 1933:256).

Johnson and Johnson provide some additional details from their research on the trails in

the Colorado Desert in California:

"Although the singular word 'trail' will be used throughout this paper, in actuality seldom, and then but for brief stretches, did any of the recorded sections contain only one trail. Almost always there were two or more subsidiaries running parallel to what might be considered the main trunk. The trails vary from six to twelve inches in width, and average one inch deep. A specific feature noted wherever enough stones were prevalent was a trail rim or ridge of stones on each side of the trail" (Johnson and Johnson 1957:23).

Another feature of the trails is stone cairns. One section of trail investigated by Johnson and Johnson contained sixty-four cairns of differing sizes, the largest being "two to three feet high with a base diameter of four feet" (Johnson and Johnson 1957:26). Occasionally, however, the cairns or "shrines" reached substantial proportions as Rogers found: "At the apex of the Mopi Pass in the Turtle Mountains of San Bernardino County, California...here three identical cairns grew so large that they eventually coalesced to become one. The total weight of the stones in the shrine must approximate three tons" (Rogers 1966:51). Johnson and Johnson indicate that at least in some cases they saw sherds present along the trail occur in "groupings" associated with stone piles or small cairns along the trail (Johnson and Johnson 1957:22-23). Rogers also notes the deposition of cultural material at "shrines" along the trails, although the data he accumulated suggested that the deposition of this material varied substantially through time (Rogers 1966:49-51).

As in the case of the Anasazi roads, the California trails have been dated only on the basis of associated ceramics, although as Rogers points out, "This does not preclude the possibility...that the Yumans in some instances used the trails of more ancient peoples" (Rogers 1966:47). In the case of the trail surveyed by Johnson and Johnson, 75 percent of the ceramics could be firmly dated to the period from 900 AD to 1300 AD, while the remaining 25 percent are less secure temporally but are thought to date from prior to 900 AD (Harner 1957:35-36).

Arizona

While there is no overview of the trails in Arizona, basic information on the trails can be found in Breternitz (1957), Vivian (1965), Rogers (1966), Kemrer, Schultz, and Dodge (1972), and Beezley and Fritz (1975). Little can be said concerning the overall pattern of the trails due to the fact that many of these research efforts are limited in scope.
The trails which have been investigated in Arizona seem very similar to those found in California and, on the basis of the materials encountered on them, appear to be associated culturally with the California system. As in California, there is a pronounced grouping of artifacts along the trails. Breternitz, for example, located several such groupings:

"They were localized at four or five points along the margins of the trail, never more than six to eight feet away from the track across the desert pavement. These concentrations have all the appearances of having once been vessels which were dropped while being carried by someone using the trail" (Breternitz 1957:13).

While some trails contained no ceramic artifacts and could not be placed temporally, others dated to the same time frame as those dated by Harner in California (Breternitz 1957:13; Vivian 1965:140-141; Rogers 1966:76-77).

While not all researchers included a physical description of the trails, those who did indicated that the widths of trails ranged from about 30 cm upward and rarely exceeded .5 m. Cairns occurred along the trails, in some cases at forks in the trail, while other larger examples occurred at passes. In some areas the trail "was cut through desert pavement of larger rocks; as the rocks were pushed aside, a slight ridge was formed marking the trail" (Kemrer, Shultz and Dodge 1972:61). Even where a ridge or berm was not formed, "...the trail is free from the rock debris which occurs on either side" (Beezley and Fritz 1975:262).

Despite the relatively small amount of information available on the trails of Arizona, the similarities with the trails in California can be seen, as well as some general similarities with trail systems elsewhere.

Nevada

Indications are that California and Arizona trail systems were connected to trails in Nevada. The information on prehistoric trail systems in Nevada is, however, extremely limited. There is a description of historic (ca. 1878) Shoshone trails and some of the features associated with them; the existence of constructed features offers some indication that the trails in question were formalized and not expected to change. Hoffman provides the following account:

"The Indians who occupy small patches of soil for permanent encampments are in the habit of selecting suitable places along the foot-trails for gathering the fruit of this tree (pinon) and storing it for future use, as well as for such of the tribe as may be unable to reach camp, or in want of food. All the Shoshonees in the southern interior of Nevada provide for one another in this manner. Their mode of doing so is in this wise: a number of stones are collected, each of them from one-half to one cubic foot in bulk, which are arranged in the shape of a circle having a diameter of from 2 to 4 feet. When fruit is abundant (which happens but once in three years in respective localities), it is collected and piled into this circle, covered over with sticks and

leaves, and finally a layer of earth, so as to secure them from rodents and birds. Still, the former more frequently discover these deposits than the benighted warrior for whom they are intended. The Shoshonees do not know of any circles connected with religious or burial ceremonies. Circles of similar construction are sometimes found upon elevated points of land, where they are located as a post from which a good view of the surrounding country can be obtained" (Hoffman 1878:473).

Colorado, Not Associated with Chaco Canyon

Limited information is available on roads in Colorado. Heavy vegetation cover in many area seems to be one on the primary deterrents to the identification of these features. William Byers provides the following account on an area above the timber line:

"At Boulder Pass, 55 miles west of Denver, an old trail or trace led where a wagon road is now built. It passes at 11,600 feet above sea level, and traverses, at that height a plateau above timber line for between three and four miles....Near what we now call Argentine Pass, about twenty miles further south on the same range, is a similar pass, by a transverse ridge, but of still greater length above timber line. Here is an old roadway which has evidently borne infinite travel of some kind. At intervals along it are circular works, apparently for protection or hiding places. Excavations of two or three feet, bordered by enclosing walls of stone, ten to twenty feet in diameter. But they are isolated and I have never observed any trace of other walls" (Byers 1878:16).

If a concerted effort were made, many more prehistoric roads could probably be located in Colorado.

New Mexico, Not Associated with Chaco Canyon

Aboriginal roads and trails have long been observed and commented upon in New Mexico. Carlton noted what he believed to be roads at the site of Gran Quivira, as will be discussed below (Carlton 1855:308). Somewhat later in the nineteenth century, Thompson made the following statement based on his observations from 1872-1874:

"Their trails are remarkable extending as they do in a straight line from one pueblo to another, and even traced from ruin to ruin. These deeply-worn paths, even on the rocks, passing without swerving to right or left, over valley, plain, or ascent of mesa--as though the trail was older than the mesas, or before the canons, gnawed into the plateaus by erosion, had reached their pathway--speak more powerfully than all else of how old a people they are" (Thompson 1879:322, emphasis his).

Bandelier was aware of the existence of a road between Zuni and Acoma, although he indicates that he traveled on it only for "a very short distance" (Bandelier 1892:325), taking most of his information concerning the route followed by the road from the Spanish historical accounts. Bandelier also mentions a trail "leading from Taos to Picuries" although he does not comment on its age or association with archaeological sites. Bandelier's comments on the trails in the area of Gran Quivira will be discussed below with other investigations of the trails at that site.

Cushing, in his research on Zuni traditions, felt that a trail of considerable antiquity had existed connecting some of the abandoned pueblos to the north with the source of salt at Zuni Salt Lake:

"Not only did a trail (used for such long ages that I have found it brokenly traceable for hundreds of miles) lead down from the cliff-town country to this broad valley to the Lake of Salt, but also there have been found in nearly all the cliff dwellings of the Mancos and San Juan section, whence this trail descends, salt in the characteristic kernels and colors found in this same source of the Zuni supply" (Cushing 1896:353).

While not offering any physical description of the trails themselves, Hewett in 1908 not only recognized trails but distinguished in his designations between trails interconnecting the ruins of Frijoles Canyon and a Navajo trail in the same area (it is not clear from the text whether this designation refers to those who used the trails or to the trails' apparent destinations):

"One must climb to the mesa top by the old Navaho trail south of the Rito, follow this a mile or two toward the mountains, and then descend by an ancient rock trail into the gorge at the site of the old Tyuonyi villages. Another ancient trail enters the canon from the north..." (Hewett 1909:437).

This would appear to be the same trail described by Harrington, who questions the designation of the trail as Navajo (Harrington 1916:421 and Map 28). Although Harrington indicates that "satisfactory knowledge about the ancient trails is surprisingly difficult to get," he records several. While some of the trails mentioned by Harrington are major links covering long distances, as is the case with "the old and still well-worn trail to the Ute Indian country," most appear to be short connections between nearby pueblos, similar in many respects to those discussed by Douglass (Douglass 1917:23). Douglass mentions trails "leading up the mesas or along the ridges" which "are all ancient trails," an assertion borne out by the location of ruins along them. A fairly clear distinction seems apparent between shorter "use trails" and longer trails, which in many cases seem to be planned.

Dutton mentions a "well-defined Indian trail" in the area "west of Jemez Springs." This

probably falls into the former category of use trail, although she does not offer a description of the trail itself (Dutton 1952:151). This is certainly the case where the trails investigated by Fliedner near Jemez are concerned. He describes the trails as being:

"About twenty inches (50 cm.) wide and eight inches (20 cm.) deep in smooth terrain....Trails running parallel or oblique to the contours are dug into the slope; the builders moved material from the hillside to the valleyside to enlarge the path...sometimes stones have been placed at the valleyside for a better foundation. In rocky slopes the horizontal or nearly horizontal trails were engraved. In some rocky ravines (for instance, north of the Battleship Rock) small half-moon-shaped deepenings for hands and feet were cut into the walls" (Fliedner 1975:374-375).

Even in cases in which the trail is not a major one, then, it is possible that its surface was prepared or maintained, as Fliedner goes on to point out:

"They cannot be confused with the trails of game if they have artificial foundations or similar artifacts. Where such artifacts are missing, the arrangement of the economic area is the most important indication, because the trails connected the different objects in the cultivated area" (Fliedner 1975:375).

Howard's discussion of the linear depressions occurring at Gran Quivira National Monument is quite interesting with respect to the question of contact-period aboriginal roads in the Southwest. The suggestion is "that these so called 'ditches' were not used in irrigation at all, but were, quite possibly, nothing more than Indian trails" (Howard 1959:85). Howard cites considerable confusion in the literature that exists on these features, concerning whether the depressions described in various accounts are canals or roads.

The cross-section of the feature excavated by Howard is suggestive of the shape described for prehistoric roads in the San Juan Basin, although not as wide as most (Ebert and Hitchcock 1975:52; Hayes 1981:46-47; Ware and Gumerman 1977:145; Lyons and Hitchcock 1977:118; Loose 1979:358; Obenauf 1980a:18-19). It is unfortunate that Howard's excavation was carried only part way through the low mound bordering the feature on either side. The excavation strategy of the test was to examine the bottom of the feature for sedimentation and the layered deposits commonly occurring in canals (Howard 1980: personal communication). The fact that nothing that could be defined as a surface was identified in the test trench excavated at Gran Quivira (Howard 1959:88-89) is perfectly in keeping with subsequent excavations on Anasazi roads around Chaco Canyon (Ware and Gumerman 1977:161-162). A more critical factor in the interpretation of the feature, the association of rubble with the borders of the roads, remains to be more fully investigated.

Eastern United States

The literature on the Indian trails of the eastern United States is vast. Two major works are devoted to this subject alone, Archer B. Hulbert's Indian Thoroughfares (1902) and William E. Myer's Indian Trails of the Southeast (1928). Neither Hulbert's nor Myer's volumes contain a single reference to any archaeological work either done on or reporting the existence of Indian trails. All of the references cited are either the reports of early explorers or those of historians.

Indian trails in the East seem to possess the same sort of depression which is characteristic of roads and trails elsewhere:

"In many instances the depression in the ground of an Indian trail can be recognized today....An Indian trail...often lay a foot or two below the surrounding ground" (Hulbert 1902:16).

The width of the trails, according to Myer, varied depending on the vegetation and terrain of the area crossed:

"In the wooded or mountainous regions of the central southern United States the Indians were forced to go in single file and the paths were usually from 18 to 24 inches in width. On the open grassy prairies of the Middle West, however, where there were no special obstacles, they proceeded en masse in such formation as suited their pleasure, and thus often made wide trails" (Myer 1928:743).

The only other attribute of eastern trails identified was "stone heaps," which may or may not have been equivalent to the cairns found widely in the western United States. These stone heaps were located along the trails in Ohio and reputedly had prehistoric burials beneath them.

The literature on trails in the eastern United States is of limited value for the present research effort, because the route of the trail is generally considered to be its only important feature, to the exclusion of its physical attributes.

Mexico

While prehistoric roads in Mexico are in some cases better documented than those in the southwestern United States, the information available is not great given the level of publication and research that has taken place in many regions of Mexico. In some cases, roads or streets are recognized in the central portions of sites, where investigation has traditionally been concentrated, but research has not been carried on in outlying areas where the roads may also exist linking the major center with smaller surrounding sites (e.g., Acosta 1965:833).

The best documented prehistoric roads in Mexico are those surrounding the Chalchihuites site of La Quemada in Zacatecas. Currently, an estimated 102 miles of prehispanic roadways dating to 700-900 AD have been mapped (Trombold 1975:1-2), and have been noted and commented upon since the first half of the nineteenth century (Batres 1971:7-12). They were first mapped by Charles De Berghes in 1833 (Kelley 1971a:XV) and again by Trombold in 1974 (Trombold 1975:2; Trombold 1976, Figure 2). These roads are constructed above the ground surface such that:

"Two parallel rows of stone are constructed in a straight line to the desired height and width. The area between is then filled with rubble and capped with flagstones" (Trombold 1976:150-151; Weigand 1978:103; Kelley 1971b:775).

Inasmuch as the La Quemada roads are masonry structures built on the surface of the ground, they are frequently compared to the sacbeob of the Maya area (Kelley 1971a:XV; Kelley 1971b:775; Trombold 1976:150).

The width of the roads at La Quemada varies "from about three to fifteen meters" (Trombold 1976:150), which Trombold divides into three size classes: "Small, between 1.0 and 4.9 meters wide, Medium, between 5.0 and 9.9 meters wide, and Large, 10-15 meters wide" (Trombold 1975:4). About three-quarters of the La Quemada roads fell into the "Small" category, about one-fifth were in the "Medium" range, and only 2 percent were defined as "Large" roads (Trombold 1975:4). While it was found that "there is apparently a random distribution of road types in relation to site size" (Trombold 1975:4), some patterning in the roads occurred, in that:

"Large and Medium roads connect areas of high population density to the central site of La Quemada. Dispersed sites in marginal areas seem to be connected exclusively by 'Small' roads" (Trombold 1975:5).

Further:

"Small roads seem to be the only type present in the southern area, perhaps indicating that the zone was less well-integrated into the economy of La Quemada than was the western zone. Many of the sites in the south, including at least one large pueblo, do not have any roads at all" (Weigand 1978:103).

Other roads and trails have been identified in Mexico and should be mentioned here, even though much less is known about them than about the roads at La Quemada. Bandelier mentions "trails" around Casas Grandes, describing them as follows:

"The old trail...is properly not wider than one meter, although it appears double that width, having been considerably eroded. It is not, as people at Casas Grandes state, cut out of the rock or scooped out of the soil, but simply worn out by much ancient travel, and it seems as if all the loose rocks, drift, or boulders had been carefully removed so as to clear it. The depth of the track is from 0.30 to 0.45 m. (12 to 18 inches). In one place, where it winds along a steep slope, it appears to be 2 1/2 meters (8 feet) wide, but only part of the width is artificial, and the remainder a natural ledge" (Bandelier 1892:564, see also 568-569).

These features are also discussed by DiPeso (1974:360-361), who not only identified trails, but also a system of signal towers used in a wide-spread system of smoke or fire communication (DiPeso 1974:362-365).

Further to the west, Hayden briefly discusses trails in Sonora:

"Malpais trails form a network which connects waterhole to waterhole and reaches in all directions toward the dunes and to the deserts beyond the Sierra. All have been carefully cleared by removing the stones and tossing them well outside the trail. This network continued to be used by San Dieguito I people and by Amargosans, and in several places the later trails detour around impassable sections of the Malpais trails. Heavily varnished flakes and tools may occasionally be found on these abandoned trail sections, along with shrines and sleeping circles" (Hayden 1976:282-283).

Maya

Maya roads will be treated as a separate category due to the overlap of the Maya area between Mexico and Central America. While this is not the most valid separation with respect to geography or national boundaries, it does reflect a distinct category recognized in the literature.

Thomas Gann was one of the first researchers to recognize roads in the Maya area and provides the following account of his discovery of the sacbe running between Coba and Yaxuna:

"About two leagues from San Juan del Chen...(we) struck what the guide had told us about,...a great elevated road, or causeway 32 ft. wide, and varying, according to the configuration of the ground from 2 to 8 ft. in height....This was probably one of the most remarkable roads ever constructed, as the sides were built of great blocks of cut stone, many weighing hundreds of pounds; the central part was filled in with unhewn blocks of limestone, and the top covered with rubble, which, as is indicated by the traces of it which remain here and there, was once cemented over. It was convex, being higher in the centre than either side, and ran, as far as we followed it, straight as an arrow, and almost flat as a rule" (Gann 1925:303).

This was one of sixteen elevated roads which originated at Coba, of which "some crossed the arms of lakes and were as wide as sixty

feet" (Deuel 1967:297). The longest of these roads from Coba is over sixty miles long (Deuel 1967:297). This represents the most extensive system of roads known at any Maya city. It has not been common for investigators to recognize roads in the Maya area. Despite this, there is some information available to suggest that they may be more common than had originally been thought, and more commonly built at ground level than elevated. Frans Blom makes the following statement concerning Maya roads:

"Sometimes the roads would be mere foot-trails, but at other times they would be wide and well-paved roads, such as have been located in the region of Uxmal, or the mighty paved highways between Coba and Yaxuna, reported by several recent explorers. It was not only in northern Yucatan that roads were found. Father Joseph Delgado traveled from Cahabon to Bacalar. On his way he was caught by 'los enemigos Ingleses,' the English pirate and renegade colony entrenched at Belize. They left the pious and pitiful padre in his underwear, and he groped along until he reached the town of Bacalar. Recounting his troubles he mentions that he: 'followed roads through the swamps, which had been built in ancient times, and still were well preserved'" (Blom 1932:547).

Blom himself located roads around Palenque: "I found huge stone buttresses on either side of a stream, indicating that a bridge of logs once had rested on these buttresses. Locating these bridges from the Michol made it easy to connect them on the ground. Slight excavation revealed the surface of a paved road connecting the bridges" (Blom 1932:547).

More recent research on the Island of Cozumel has revealed that roads occur here as well, although the need for formalized routes of ground transportation on a small island such as this might seem small:

"A number of stone paths or sacbes were found on Cozumel. Most of these connected areas within settlement zones, but some were found to connect different settlements. The best-preserved of the intersite sacbeob, running between San Gervasio and the northeast coast, was mapped for about five kilometers before it was lost in a small settlement. About 1.5 meters wide and averaging less than a meter in height, this sacbe had small shrines interspersed along its length" (Freidel and Leventhal 1975:68).

One element that allowed these features to be followed for an extended distance was the changes in terrain. It was possible in most cases to follow the coursed masonry at the edges of the sacbe in higher elevations although some stretches did not show any surface indications. At lower elevations the road was often elevated to rise above areas of swamp and could therefore be easily plotted (Richard M. Leventhal 1981: personal communication). Because of the straight path followed by the roads, even when a section was lost, the bearing could be maintained and the road picked up again in survey further along the route.

It is probable that many more Mayan roads exist than are now known. The dense vegetation common in the Peten rules out most of the techniques developed for the investigation of roads in other areas. It is presumed that, as additional work is carried out away from the urban centers of the Maya lowlands, new roads will be discovered.

South America

The most extensive pre-western road system in the New World and also the best-documented is the Inca road system, centered in Peru, which is made up of 10,000 miles of paved highways (Von Hagen 1974:33). While Von Hagen's statement is somewhat exaggerated concerning the paving, it is relatively accurate with respect to the extent of the system:

"Two main roads ran the length of the Empire, one along the Coast and the other in the Highlands, while transverse roads connected all important towns with these roads and with one another" (Rowe 1946:229).

One of the most frequently cited features of the Inca roads is their straight course. Willey describes this in the coast road as it passes through the Viru Valley:

"...which passes in an absolutely straight line through the Lower Valley. Coming up the coast, it runs 14 kilometers in a southeast-northwest direction" (Willey 1953:370).

The road was bordered by a wall in many cases. In other cases, the border of the road was substantially less formalized, consisting only of stones placed along the margin of the road surface (Kroeber 1930:90; Ford and Willey 1949:33-34; Willey 1953:369-370). At places of least formalization, in uninhabited areas such as "the sandy trackless deserts, they consisted of no more than twin lines of posts to mark the trail" (Mason 1968:166; see also Rowe 1946:230).

Cairns occurred along the roads, but were limited to areas where the road passed over high ridge or summit. The context of these seems to be identical to the context of those found on summits along trails in the western United States, and the traditions concerning the use of cairns in these positions appear similar (Von Hagen 1955:67).

The width of the roads seems to vary substantially according to how near they are to a settlement, the size and importance of settlement, and the difficulty of the terrain (Kroeber 1930:90; Rowe 1946:230; Willey 1953:369-370; Kosok 1965:229; Lumbreras 1974:229; Von Hagen 1974:35). As Kosok put it:

"With rare exceptions, the ancient roads were widest and best constructed where they crossed the cultivated and populated parts of

the valley. However, in the desert areas between valleys the roads became narrower and, finally, both walls and road disappeared altogether" (Kosok 1965:137).

The widest roads occurred along the coast in relatively even terrain, where the main roads were about ten meters in width (Willey 1953: 370; Von Hagen 1974:35). The roads through the sierra were only about five meters in width (Von Hagen 1974:35). The secondary roads connecting smaller settlements either to each other or to the main roads seemed to vary more than any other group, but generally stayed within the five-to-ten meter range (Kroeber 1930:91; Willey 1953:369-370; Mason 1968:166; Lumbreras 1974:229).

The surface preparation of the roads fell into the same pattern as the width of the road and the construction of walls along it. Thus, where the road was generally better constructed near settlements, the surface would often be paved; but as the general trend of formalization decreased away from towns, the surface might only be cleared of rocks and debris (Rowe 1946:230; Kosok 1965: 137; Mason 1968:166).

Where roads crossed uneven terrain, retaining walls were used to either ensure that the road would not wash out or to increase the surface area of the road on steep inclines (Rowe 1946:230; Von Hagen 1955:229; Lumbreras 1974:229).

Another interesting feature of the Incao road system is the signal system. A fire and/or smoke signal system apparently was used for urgent messages (Bram 1941:37; Rowe 1946: 232). While the way in which the system functioned is not entirely clear, the very existence of such a system is of interest.

Another important aspect of the Inca roads is the existence of parallel roads, used exclusively and contemporaneously by different portions of the population:

"There existed along the sea five roads that crossed the Lurin Valley. The fifth... bordered the sea and belonged to the chasques. The fourth served the traffic in which fish was carried to Lima...there is no indication of who used the remaining roads" (Rostworowski de Diez Canseco 1977:170).

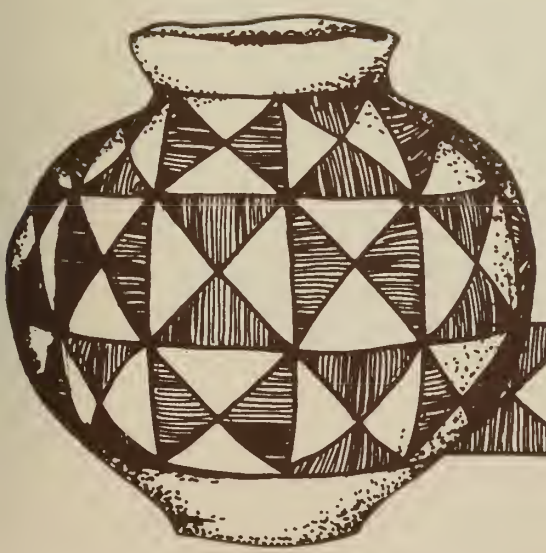
Rock-cut or masonry stairs are a common feature of Inca roads in the Andes (Mason 1968:165; Von Hagen 1974:35). Unlike the situation with road surfaces, there does not seem to be a range of formalization in the stairways. Rather, when they occur it is in the form of full-fledged stairways. Hand-and-toe holds do not seem to have been used. This may have been the result of the use of llamas as pack animals, necessitating routes which could be traveled by animals.

While the Inca culture certainly used these roads, and were controlling them at the time of Spanish contact with Peruvian culture, many of the roads in question probably date to a much earlier period (Kosok 1965:117, 153, 162-163). Part of the problem in dating the roads is that the structures along them have provided the information used by most investigators (Kroeber 1945:72; Ford and Willey 1949:34; Willey 1953:369-370). However, Inca structures could easily have been superimposed on an earlier existing road. Datable artifacts associated with the roads do exist, although they have not commonly been used in attempts to date the features (E. B. Dwyer 19769: personal communication).

Chapter Summary

Formalization of routes of communication and exchange is not uncommon in the New World; formalized routes have been loosely sorted by previous researchers into two groups, roads and trails or paths. The major distinctions between roads and trails appear to be with respect to two attributes, width and degree of construction. Although exceptions were found, in general trails appeared to be no more than 1.5 to 2 m in width, while roads varied from a few meters in width to up to 15 m in some instances. The consistently greater width of formalized roads is no doubt due to more extensive construction. Roads had true constructed surfaces, either elevated, excavated or level with the ground, which were purposefully prepared. In most cases, more extensive construction was found in proximity to large towns or settlements and in areas of rough or marshy terrain, where it was needed to facilitate access. For trail systems, construction activities were for the most part limited to clearing of surface materials, and minor leveling or stabilizing. Straightness was a common attribute of both road and trail systems, as well as the existence of parallel routes of travel. The association with cairns or other types of construction features at high points or passes along the routes is another shared trait.

The present chapter has been limited to a consideration of morphological attributes only; the goal has been principally to establish a basis for the evaluation of the technological complexity and degree of preservation which might be observed for Chacoan roads. Clearly, a more intensive comparative study would be necessary to explore the issue of how formalized road systems functioned to integrate prehistoric societies; such a study would no doubt prove informative and aid in the interpretation of Chacoan roads, but has not been undertaken for this project. A more detailed examination of the similarities between Chacoan and Peruvian roads is considered in Chapter 6.



CHAPTER 3

CHAPTER 3

IDENTIFYING AND INTERPRETING CHACOAN ROADS: AN HISTORICAL PERSPECTIVE

Purpose and Scope

To a large extent the research strategy of the present Chaco Roads Project is based on the results of past research on Chacoan roads. In general, this has been true of other recent projects carried out in the San Juan Basin that occasionally specifically dealt with Chacoan roads or, more often, included them among the cultural features to be identified and interpreted on areal and other surveys. With few exceptions these studies have not explicitly considered previous road-specific methodological strategies or theoretical assumptions. The body of descriptive literature on Chacoan roads has increased significantly, but correlative and comparative conclusions have been only implicitly assumed. At the same time, these studies have provided data for consideration of a larger Chacoan road network, a major cultural feature that has begun to figure prominently in explanatory models for the "Chacoan Phenomenon."

Because the Chacoan road data base is expanding at a significant rate, though mostly in piecemeal fashion, it is appropriate in this study to provide some historical perspective on past research. In addition to serving as useful background information, a more explicit consideration of past research can make the methodological and theoretical concepts outlined in the following chapters clearer and the evolution of these concepts more easily understood.

The following synthesis traces the "rediscovery" of Chacoan roads after a hiatus of almost forty years and documents the data acquired on the known road systems over the past decade. Changes in methodology and methodological concepts employed in identifying Chacoan roads are also discussed, as are the theoretical concepts that directly or indirectly influenced methodology.

This synthesis of past field studies is based on a variety of data. Many of the earlier studies, especially those conducted in or near Chaco Canyon, did not result in published reports. A few unpublished reports have been produced, but in several instances only brief field notes are available. This situation has been improved by the inclusion here of a more detailed presentation of information collected by the R. Gordon Vivian study in 1963-1964 and the R. Gwinn Vivian studies of 1967 and 1970-1971. While the material presented here both updates and expands upon Gretchen Obenauf's excellent review of previous investigations of Chacoan roads (Obenauf 1980a), it cannot be guaranteed that some unpublished research on Chacoan roads has not been overlooked. While gathering data for this chapter, it became clear that numerous individuals had at one time or another "investigated" segments of Chacoan roads, mentally filing most of the information while intending to "write it up" someday. Presumably, this report can serve (as has Obenauf's) as a starting point for a more comprehensive synthesis of past field work. For the sake of convenience, the review of field studies has been placed in Appendix A of this report.

There has been less of an attempt made here to include a complete consideration of all reports that use the Chacoan road system in an interpretive framework. The summary of interpretive studies is limited primarily to projects that had roads or Chacoan outliers as their primary focus of research. Some other studies have been included, but the interpretive synthesis is not an exhaustive documenting of all published references to Chacoan roads.

Discovery and Description of Chacoan Roads

Early References

Although several early Spanish chroniclers (Bolton 1952:178; Hammond and Rey 1940:182) and a few later American surveying or military parties (Ives 1881:122; Thompson 1879:322) reported "roads" or "trails" extending out from inhabited or recently inhabited pueblos, there is no good evidence that any of these routes were purposefully constructed or were a part of the known Chacoan road network. Because most of the San Juan Basin was not explored by the Spanish or Mexican governments in New Mexico it is not surprising that road segments were not recognized and reported until American surveying parties began to push into the Basin.

The first reference to a Chacoan road may have been made by Oscar Loew, a member of the Lt. Wheeler Geographical Survey, who visited "Pueblo Bonito" (Pueblo Pintado) in 1874 and observed "traces of a former road to Abiquiu, sixty miles off" (Loew 1875:176). The possibility that this "road" was Chacoan in origin is suggested because road segments are known at Pueblo Pintado. On the other hand, no roads investigated at this site go to the northeast and the road in question may have been a historic trail following the frequently used route through the Chama Valley into the Dinetah and points south.

In the following year, Lieutenant C.C. Morrison, a member of the Sixth Cavalry accompanying the Lt. Wheeler Geographical Survey also visited the Chaco area and in his report corrected Loew's use of the name Pueblo Bonito for Pueblo Pintado. Morrison's route took him by the site of Kin Klizhin.

He reported that "the ruin was on a slight elevation above the valley. From opposite the face of the former ran a built wall of earth, with stone revetment across the drain, possibly a roadway with bridge, more probably a dam, 10 feet across the top, 5 feet high, and 15 feet across the base" (Morrison 1876: 360). If Loew was not observing a Chacoan road (since Morrison was observing a dam) the honor of reporting these features must go to S.J. Holsinger, a Special Agent for the Government Land Office, who was sent to Chaco Canyon in April 1901 to investigate the Richard Wetherill homesteading claims. Holsinger's report provides an amazing quantity of archaeological data, including a description of a road segment linking Pueblo Alto with Chetro Ketl. It seems fairly likely that Holsinger's reported archaeological observations stemmed, in part, from discussions with Richard and Marietta Wetherill; however, despite this fact, he had an acute eye for detail and good reporting skills.

Holsinger (1901:67-68) wrote of the Pueblo Alto to Chetro Ketl Road:

"The remains of an ancient road-way,...can be traced from Chettro Kettle stairway to Alto ruins. This roadway was 20 feet wide and walled up to a grade with loose rock and filled with soil. It commenced near the top of the stairway referred to and followed a narrow shelving or terrace of the rock, westward, paralleling the canyon. It followed this ledge for about a half mile to a point where there are indistinct remains of a broad flight of steps, twenty-one in number."

Holsinger observed that this road segment appeared to be related to another feature in the vicinity, "a groove cut in the top of the rock" below Pueblo Alto and north of Pueblo Bonito. This particular road segment was later identified by Vivian and Buettner as Segments F and B on their Alto System Road Map (see Figure A-2).

In addition to this road segment, Holsinger reported a number of wide rock-cut stairways, including Jackson's Stairway, but did not associate any of these features with other roads. A visit to Kin Ya'a near Crownpoint provided data on a "canal, now 20 feet wide, on the bottom, (that) passes within a few yards of the ruins" (Holsinger 1901:41). This feature has since been identified as a road. Holsinger's identification of a "ditch" at Kin Bineola is very likely correct, though Lyons et al. (1972) and Marshall et al. (1979) prefer to view the feature as a road, "ceremonial way" or "Avenida Kin Bineola."

It seems fairly certain that Holsinger was reporting features that were known to the Wetherills. The fact that they were aware of some Chacoan roads is corroborated by a memorandum of October 29, 1948 from Gordon Vivian to Irving McNeil, then Superintendent of Chaco Canyon National Monument, in which Vivian reported discussing Chacoan roads, among other things, with Mrs. Marietta Wetherill:

"North of Alto in certain lights you can still see what appears to (be) a wide roadway running down to the Escavada. In the old days this was very clearly defined in the spring or early summer because the vegetation on it was different from any other and it could be traced clear to the San Juan" (Vivian 1948).

With increased investigation of prehistoric sites in the San Juan Basin (generated initially by persons such as Loew, who accompanied government geographical survey parties) a number of early twentieth century archaeologists working in the area reported Chacoan roads, or features that were probably roads. Earl Morris probably had been aware for some time of the road near the Aztec Ruin. In a 1915 publication, Morris remarked that the stone used in the Aztec Ruin "was brought over a broad road which is still visible, winding over hills and across arroyos to the quarries some three miles to the northwest" (Morris 1915:666). A year later a photograph of a portion of this road appeared in an issue of El Palacio with the caption:

"Ancient Road Near Aztec, N.M.: The road is perhaps thirty feet wide, its sides being marked with pebbles and boulders. It is very well defined and may be seen from the train several miles away. It was used in hauling stone from a quarry two miles over the hill" (Wadleigh 1916:52).

The photograph, which was credited to F.A. Wadleigh of Denver, shows a portion of the road that ascended a low hill with a horse rig on the road at the base of the hill.

A more complete description of the "Aztec Ruin Quarry Road" was given by Homer Hastings in 1960 who noted that land modification activities threatened to obliterate this feature which had been known to local inhabitants since the 1880s. The hill in the early photograph was now identified as Airport Hill and the segment of road on the hill was described as extending "a distance of about three hundred and seventy-five feet" (Hastings 1960:72). It was further noted that "stones had been thrown into ridges, now one foot high on either side, giving the effect of a road averaging forty-eight feet in width" (Hastings 1960:72). Hastings cited the quarry theory as an explanation for the road but also mentioned access to the Knickerbocker Hills about four miles east of the town of Aztec which may have been used "as a signal point when messages were being relayed from Chaco, via Huerfano Mountain" (Hastings 1960:72).

J. Walter Fewkes was aware of the Aztec road when he reported on sites in the vicinity of Crownpoint, New Mexico on the South Chaco Slope in 1917. In describing his investigation of Kin Ya'a he stated that "a well blazed trail passes the ruin and is lost

in the distant hills" (Fewkes 1917:15). Fewkes went on to remark that the trail had been mistaken initially for an irrigation ditch, but the fact that the trail ran up a steep hill precluded its use for transporting water (unless, of course, the water was running in the opposite direction, an alternative apparently not considered by Fewkes, though his point is well taken). Fewkes observed that other similar trails occurred "elsewhere in the State," and that such routes were probably used for transporting building stone, mentioning the road segment near the Aztec Ruin to support this theory.

Paul Martin (1936:18) may have observed and recorded a segment of road at the Lowry Ruin during his work at this site in the early 1930s. He comments:

"I should, however, like to call attention to the shallow, dry foss or ha-ha about one foot in depth and from fifteen to twenty feet wide. This ditch lies between the great kiva and the Pueblo extending for a half mile or more north and south beyond the ruin. I was unable to determine whether or not this shallow depression was of a natural or an artifical origin or to determine its purpose."

The interpretation of this feature as a water control device may have been shared by Al Lancaster who worked with Martin at the site. Woosley (1980:324) in referring to the Lowry Ruin, states "Lancaster defined other irrigation ditches. One ditch runs 480 m in a northeasterly to southwesterly direction between the great kiva and restored roomblocks. It is shallow and approximately 10 m wide. Another, slightly narrower, ditch has its head in the easternmost, unexcavated roomblock (Lancaster, personal communication, March, 1979). It, too, can be observed for approximately 480 m before it is obscured by modern fields."

Another segment of road beyond the general vicinity of Chaco Canyon was reported, but apparently not observed, by Winifred and Harold S. Galdwin in 1928. Gila Pueblo surveys in the Chuska Valley resulted in site recording of a number of Chacoan structures including the Chimney Ruin (Gila Pueblo site designation Chaco 9:48). This same site is reported by Marshall and others (1979:109-113) as Skunk Springs. Gladwin's site form has the remark that "the Navajo say that a clay road was once built from this ruin to Pueblo Bonito, a distance of 35 miles, over which the pine logs were carried from the Chuskas to build the great pueblos at Bonito. Sections of the road are said to be still in use by the Navajo" (Gladwin 1928).

Obenauf (1980a:34) cites a personal communication from Marjorie Lambert as evidence that Edgar Hewitt was also aware of Chacoan roads. Apparently, Hewitt was familiar with a road connecting Chaco Canyon and the Aztec Ruin as well as shorter segments on the cliff top north of Pueblo Bonito. According to Lambert, Hewitt thought that roads would be discovered leading from Chaco Canyon into Mexico.

Unlike Hewitt, who provided no written description of these cultural features, Neil Judd was not only well aware of Chacoan roads but published both textual and photographic evidence of them and apparently planned eventually to publish a separate report on roads (1964:350). Judd's data on roads are given in short references in his two volumes on Pueblo Bonito (1954, 1964) and consist of both personal observations and descriptions by Navajo informants collected during his work in the Canyon from 1921 to 1927.

Judd appears to have been personally most familiar with road segments in Chaco Canyon or its immediate vicinity, particularly the system linking Pueblo Alto with several canyon-bottom sites. Photographs in his 1964 publication can be identified as rock-cut steps and the "grooved" area on the Pueblo Alto to Chetro Ketl Road identified by Vivian and Buettner in 1970-1971 as segment B, and a cleared section of roadway on what Vivian and Buettner called the Chetro Ketl to Tsin Kletzin Road.

Judd (1964:142) stated that rock-cut stairways were present at "every other major P III ruin in Chaco Canyon and broad pathways lead from one to another." He briefly described several stairways, including Jackson's, and the grooved roadway noted by Holsinger almost thirty years earlier. His Navajo informants, particularly Hosteen Beyal, supplied information on roads outside Chaco Canyon. Judd (1954:346) states that:

"When asked about the so-called 'roads' on both the north and south cliffs, Beyal remarked that they were not really roads, although they looked like them. He says they were built by the Chaco people. One road led from Pueblo Pintado to Pueblo Bonito and on to Penasco Blanco. Another led from Pueblo Bonito to Kin-yai; a third, from Kinbiniyol to Kin-yai; still another, from Kinbiniyol to, or through, Coyote Canyon and on to a point near Fort Defiance. On each of these 'roads' one could see, until recently, cuts where the road passed through small hills."

Obenauf (1980a, Figure 7) has produced a schematic map of the routes reported by Beyal. A second informant, Padilla, thought that a cut through a hill in South Gap might have been a wagon road, though other Navajo considered it a canal. However this cut, which Judd had observed himself, was thought to be another segment of Chacoan road.

Judd apparently supplied the information to the anonymous author of "Prehistoric Chaco Canyon 'Roads' Puzzle Scientists," a brief article in the New Mexico Highway Journal of March, 1928. This short note is interesting in that it contains information obviously

collected by Judd, but which is not included in Judd's 1954 or 1964 publications. This suggests that more data may be present in Judd's field notes on these features, particularly if he intended to publish separately on them. The article reports that:

"The stairways are from 5 to 10 feet wide and some of them have a 10-in. tread. The roads, if that is what they were, vary in width from 15 to 20 ft., and are usually lined with boulders, which were rolled to one side in the clearing process. On sloping ground the lower side of the road was built up, and where the mesa changes levels abruptly, steps were cut in the rock" (New Mexico Highway Journal 1928).

Judd is credited in the article with suggesting that some of the roads may have been used for transporting logs used in the construction of Chacoan towns. "In tracing the roads as far as he was able,... Mr. Judd found that they all seemed to lead back into the rincons, where pine trees formerly grew" (New Mexico Highway Journal 1928:9).

Field Studies 1963-1980

Following Neil Judd's and Edgar Hewitt's work in the 1920s most subsequent research in Chaco Canyon was carried out by the University of New Mexico (UNM) field schools or in more limited cases by the National Park Service (NPS). The UNM field school work was confined primarily to small village sites, and the NPS projects were mostly salvage-oriented or done in connection with ruin stabilization. Emphasis on exploration of the large Chacoan towns, so prevalent in the previous four decades, was reduced substantially, with the result that investigation of cultural features ancillary to towns was neglected. Water control devices, roads and Chacoan outliers, all recognized in the 1920s and early 1930s as a part of Chacoan prehistory, were essentially forgotten, or in some cases were denied as ever having existed. Brand (Brand, Hawley and Hibben 1937:114), for example, stated in reference to the use of ditch irrigation in Chaco Canyon that there was "neither evidence or need for such an assumption."

The focus of interest in Chacoan archaeology shifted again in the 1950s and early 1960s as a result of research conducted by Gordon Vivian. This research had a direct bearing on future investigation of Chacoan roads. A detailed discussion of all major field studies concerning roads undertaken between 1963 and 1980 can be found in Appendix A of this report.

Definition and Interpretation of Chacoan Roads

Introduction

The review of information presented in Appendix A makes it fairly evident that past field studies and remote sensing laboratory work have produced a major body of data on Chacoan roads. Whereas much of the earliest information was gathered without regard to specific archaeological problems, more recent research has been designed to identify and define Chacoan roads and the Chacoan road network, and to interpret this cultural phenomenon. Several methodological studies have made significant contributions to the problem of road identification both on the ground and utilizing aerial imagery, and a number of recent reports consider questions of prehistoric political, social and economic development in the Chaco Basin with respect to a site-linking road network. Many of these reports focus on Chacoan outliers and evaluate the strong interdependence of roads and outliers in Chacoan culture during the eleventh and twelfth centuries AD. Road research also produced ancillary studies on methods of road alignment, communication systems and energy expenditure.

Some of the methodological and interpretive results of field and remote sensing research on Chacoan roads are summarized here. General research trends are reviewed, and field and laboratory projects discussed in Appendix A are categorized as examples of particular research orientations. This basically chronological summary is followed by a synthesis of some of the models, propositions and other constructs that have used road and outlier data to explain social, political and economic development in the Chaco Basin. Most of these are variations on economic redistribution models; some stress spatial analysis, others emphasize economics. Ancillary studies are also briefly reviewed.

General Research Trends

Three general trends in Chacoan road research have been identified: discovery and description, definition and interpretation. These trends are roughly chronological in development, though discovery, description and definition continue to the present. More detailed descriptions of specific projects discussed here are provided in Appendix A of this report.

Prior to Judd's research on Chacoan roads essentially all references to these features were discovery reports of short road segments, usually in the vicinities of Chacoan sites. Despite their usual brevity, these early reports were remarkable in several ways, not the least of which (considering the recent high degree of interest in these features) was the almost offhand acceptance by these researchers of the existence of wide prehistoric roadways. There was a vague awareness that within the San Juan Basin one might expect to find vestiges of these roads which in some cases were reported to extend great distances. With few exceptions there was little reluctance to call these features roads rather than trails or paths, presumably reflecting the reporter's awareness that these were not

simple foot paths. Most archaeologists were cognizant of a cultural affiliation with Chaco Canyon, and several commented on the fact that the roads seemed to link Chacoan sites or to connect outlying sites constructed of Chacoan masonry with Chaco Canyon. The roads' use for transportation was generally assumed, transport of building stone and logs most commonly being suggested. In some instances roads were confused with irrigation ditches, a situation that dated back to at least the time of Lieutenant Morrison.

It was not surprising, therefore, when Neil Judd located roads or "ceremonial highways" in Chaco Canyon, the center of Chacoan activities. Judd included roadways as one of several cultural features occurring in Chaco Canyon to be investigated in his Chacoan research. A number of distinct segments were identified and morphological data on them gathered. This work formed the basis for later descriptive accounts. Though Judd was personally most familiar with roads within Chaco Canyon, he was aware of links to other Chacoan sites outside the Canyon. Like Gladwin, he accepted Navajo informant descriptions on the extent of the system. His interpretation of roads was limited to functional explanations, and like earlier researchers, Judd proposed localized resource exploitation. His reference to "ceremonial highways" (Judd 1954:350), however, implies that he viewed road building for religious purposes as a viable alternative to resource exploitation and transport.

Gordon Vivian's description of some Chacoan roads added to the limited data base, even though in many instances he believed that he was describing water diversion canals. Methodologically, his use of aerial photographs pointed to an obvious and critical tool and approach for future investigation of these features.

Work on Chacoan roads that was primarily discovery- and description-oriented peaked and declined in the early 1970s. Vivian and Buettner re-investigated and recorded several road segments described by Gordon Vivian (some of which had also been reported by Judd, Holsinger and others) and located additional segments using aerial imagery. Their testing, and that of Gwinn Vivian in 1967, of various roads and road-associated features produced additional descriptive data, particularly on ramps, curbing and masonry stairways.

Much of the NPS Chaco Center work in the early 1970s added to the inventory of known roads and road-related features through survey efforts in and around Chaco Canyon. In addition, Loose's tests at Penasco Blanco and Pueblo Alto produced new descriptive data. Most of this effort, like that of Vivian and Buettner, was focused on features close to or in Chaco Canyon. Beal's brief investigation of a road segment south of Chaco Canyon should be included with these descriptive studies.

A shift to more precise definition of Chacoan roads and a possible road network followed and somewhat overlapped the period of discovery and description. Gordon Vivian's testing, mapping, recording and use of aerial photography initiated methodological refinement for identifying Chacoan roads, and Gwinn Vivian's work in 1967 on a ramp (identified at the time as a pour-off structure) ultimately was of similar value. Vivian and Buettner's work was motivated by their desire to distinguish between roads and water control features, particularly canals. Though their results were primarily descriptive, they were able to define two classes of roads based on size, which they termed primary and spur roads. They also determined that road width within each class was fairly standard. In addition, they were able to isolate a number of constructional features clearly associated with road building. These include excavation to a level surface, curbing of various styles, rock-cut and masonry stairways, hand-and-toe hold stairs, ramps, and platforms. They also noted grooves cut into bedrock on two road segments and presumed they were for defining road boundaries. Vivian and Buettner followed Gordon Vivian's use of aerial photography (mostly the 1930s SCS imagery) and through this process identified several segments not reported previously.

Research by the Chaco Center other than the Remote Sensing Project built on and added to definitional techniques and criteria for road studies initiated by Vivian and Buettner.

One of the most important definitional studies undertaken on Chacoan roads was that of Prescott College. Though the study area was limited, the research design was well formulated and the morphological attributes defined for road identification at several "observation platforms" were particularly well conceived. This study established the critical importance of aerial imagery in road identification, the varying benefits of different film types and the crucial need for on-the-ground verification of imagery-deduced conclusions. This particular research ushered in a new phase in Chacoan road study.

Recommendations made by Ware and Gumerman (Gumerman and Ware 1972) for future investigation of Chacoan roads using aerial imagery were essentially not used by the NPS Remote Sensing Project (RSP) crews assigned to carry out research on Chacoan roads in 1973. Basically, the purpose of the RSP work (in addition to explaining roads culturally in the Chaco area) was similar to that guiding the Prescott College project--to develop methods for better definition of Chacoan roads and associated features both on aerial photography and on the ground. The study area was expanded but not precisely

defined to include areas previously investigated by Vivian and Buettner and contiguous areas. Analytical techniques included experimenting with several film types and using several pieces of equipment designed to enhance object identification on imagery.

The results of the Remote Sensing Project were mixed. While several hundred "new miles" of road segments were added to the known inventory, many of these miles could not be identified positively on the ground. Ware and Gumerman had dealt with this problem and suggested solutions, but the RSP did not follow up on the these recommendations. Aerial imagery became quite important for locating road segments away from the Canyon, but ground verification was often impossible. Both Hitchcock and Morrison developed lists of road constructional features and road-associated structures, thereby expanding the basis for morphologically defining roads. Morrison made a major contribution by defining most of his terms--a deficiency in earlier descriptive studies. Later more limited RSP investigations of Chacoan roads were preponderantly descriptive.

Though Ware and Gumerman had defined sherd scatters as an attribute of Chacoan roads (Buettner also noticed this in his field work and made collections in a number of locales--these collections are curated at the Chaco Center), Morenon used this attribute as a major basis for defining the location of Chacoan roads. Morenon was faced with the problem of having to ground verify most of the roads in his study area in an environment that did not contain much sandstone outcropping or pronounced relief; that is, in areas unlike Chaco Canyon. Morenon's problem was a decided benefit for advancing the state of road definition as it called for developing recognition criteria unrelated to the physical environment. Faced with the same problem the year before, the RSP staff solution was to rely almost exclusively on aerial imagery identification. Morenon's approach added a positive dimension to road identification; though his results have been questioned (e.g., Flynn 1981), his premise, techniques and basic results were sound.

Gordon Vivian, Vivian and Buettner, Ware and Gumerman, and Loose all tested Chacoan roads and added to morphological attribute trait lists for these features, but Brethauer may have been the first to trench through Chacoan roads in an attempt to define road location and construction techniques by cross-sectioning them. The results of these tests were inconclusive because Brethauer was not able to distinguish road surfaces or road edges in the trench profiles. He was fairly certain that he was on the roads, but since they were not ground-visible in the project area he had to rely on aerial photography and line-of-sight orientation to determine the location of his test trenches. The possibility remains that he was off course on some of the road segments.

The Public Service Company of New Mexico-Historic Preservation Bureau (PNM-HPB) project expanded the horizons of road identification and interpretation as a result of more a regional research orientation. The shift was from tracing roadways extending from Chaco Canyon or towards Chaco Canyon from a few outliers to a phase of outlier discovery and description. It was presumed that roadways would be one of the attributes characterizing Chacoan outliers, and road discovery and description was one of the study goals. Methodologically, previous techniques including aerial reconnaissance and use of aerial imagery were employed for outlier discovery. Discovery procedures were guided by predictive models for outlier location based on several criteria including localized edaphic and moisture conditions. The PNM-HPB researchers determined that Chacoan outliers were often regularly "spaced" along roadways (a conclusion drawn by Morenon as well). Linking regularly-spaced known outliers with hypothetical roads in areas where roads had not been discovered allowed for the projection of potential roadway corridors between outliers. The tentative identification of two classes of outliers--production sites and transportation sites--also refined procedures for road discovery. (Morenon had also distinguished between at least two types of road-related sites.) Transportation sites were predicted to be associated with roads. Like Morenon's work, the PHM-HPB study directed research away from Chaco Canyon and forced field crews to develop means for locating and identifying Chacoan roads in zones that yielded minimal surface evidence of roadways. This stimulated development of more refined techniques for roadway identification.

Both Obenauf and Flynn worked toward more precise definition of "linearities" observable on aerial imagery, but with somewhat different aims. Obenauf assumed that most linearities in the vinicity of known Chacoan sites (Canyon sites and outliers) were prehistoric, and the purpose of her study was to extend the known range of these features. Using small scale imagery (mostly USGS) she attempted to locate roads between outliers and between Chaco Canyon and outliers. Some of her work coincided with and complemented the PNM-HPB outlier research. Flynn utilized similar imagery and identification techniques covering much the same geographic area as Obenauf. Though his stated purpose was to demonstrate that given suitable methods and techniques researchers could distinguish prehistoric from historic roadways on aerial imagery, his own methodology, techniques and conclusions appeared to be somewhat biased by a disbelief in a prehistoric road system in the San Juan Basin. It should be noted that this position was not explicitly stated in his report but was strongly implied.

Interpretation of roadways within the context of Chacoan cultural development in the San Juan Basin increased as data on these features accumulated. As previously noted, the earliest explanations for roads involved exploitation and transport of localized resources. Judd seems to have introduced the concept of a possible religious function, a theory that was seldom cited later, though Obenauf (1980a:86) notes that "religious integration" would be enhanced by a road network, especially if Chaco Canyon was viewed as a "ceremonial center" for the Chaco or San Juan Basins.

Because Gordon Vivian and Vivian and Buettner initially collected roads data as a result of water control investigations, their research goals were not structured to include communication systems within their interpretive frameworks. Gordon Vivian did not complete his research, and Vivian and Buettner were unable to thoroughly evaluate the implications of road data for cultural interpretation. In the latter case, however, Vivian and Buettner did comprehend some of the cultural implications of roads, particularly the importance of site linkages within the Canyon. Their water control study had suggested that while Chacoan towns within the Canyon might have held the agricultural rights to particular parcels of land, a Canyon-wide system of water conservation, including standardized water control features, implied a possible pan-town federation, at least for agricultural production. General uniformity in town planning, veneer styles and other architectural features bolstered this concept and the discovery of roads as tangible links between towns reinforced it even more.

Ware and Gumerman (1977:135) explicitly stated their decision to not "consider the function or social consequences of the prehistoric land route system in this paper...."

The Remote Sensing Project of 1973 marked the point at which research on Chacoan roads began to be designed not only for refining discovery and identification techniques but for interpreting these features in their cultural milieu as well. Ebert and Hitchcock, and to a lesser degree Morrison, in their project field reports stressed the need to consider theoretical issues in research designed for road study. A summary statement on the project goals and accomplishments prepared by Lyons and Hitchcock (1977) only peripherally treats cultural implications of Chacoan roads, but a report authored by Ebert and Hitchcock (1980) combined Ebert's interest in locational modeling with Hitchcock's focus on social, political and economic organization in Chaco Canyon. This contribution is reviewed more fully later, as is Morrison's ancillary study of road alignment and orientation.

Morenon sought explanations for Chacoan settlement interaction and particularly the relationships of rural and urban components. He was also concerned with how roads served to connect settlements and settlements with resource areas. An ancillary study on energy expenditure in transport and the value of roads in reducing these energy costs resulted from his study as well. His research is considered more fully below.

While the PNM-HPB work produced a new large data base on Chacoan outliers, Loose's work with the project, especially his Research Design published in the project report, was significant in its treatment of the functional and social aspects of roads within large interaction spheres in the San Juan Basin. This work more closely defined the scope of the "Chacoan Phenomenon" and placed the road network in better perspective (with respect to the Basin), even though few road segments were positively identified during the field work.

Obenauf's conclusions relative to explaining Chacoan cultural development were broad and general. This had some value, however, for despite an inclination to accept an economic explanation for roads (redistribution of goods), she noted social integration, communication and religious integration as equally plausible motivations for road building. Ultimately, she implies a multi-functional cause for the creation of the network, a conclusion that should be given more emphasis.

Despite a significant corpus of data on roads, skeptics remained in more recent studies. Brethauer (1978:32) concluded that "it is difficult to conceive of a prehistoric population living in Chaco Canyon that was sufficiently organized, technologically advanced, and economically secure to exert the considerable efforts necessary to construct elaborate roadways for the entire 500 miles of road that are thought to exist. Not only would such an assumption counter evidence about the nature of the roads, it also flies in the face of a logical interpretation of prehistoric life in the Chaco Canyon area." Flynn (though he does not reference him) essentially agreed with Brethauer (1978:32) who had commented that Chacoan populations may have maintained "a rudimentary form of foot communication between culturally related villages," but not roads. Because he thought that most of the linearities observed on aerial imagery were historic roads, Flynn did not need to explain a cultural feature that he did not believe existed.

Models for Explaining the Chacoan Road Network

Several major studies outside Chaco Canyon that began as early as 1973 confirmed the existence of a number of segments of prehistoric roads in the San Juan Basin and led to the discovery of many Chacoan outliers in the same area. This prompted speculation that outliers were linked to Chaco Canyon by

roads, despite the fact that the only road that had been verified to any extent on the ground (by several different groups) was the "Great North Road." The level of study on what is referred to by some as the "Great South Road" (Chaco Canyon to Kin Ya'a) was almost as complete, though there were several "gaps."

The cultural implications of a network of roads linking Chacoan sites in an area presumed by some to have never evolved a complex cultural system (for example, see Brethauer 1978) were rather profound. The ramifications of such a network for political, social and economic aspects of cultural development in the Chaco Basin called for explanatory models that analyzed complex inter-site relationships on a regional scale. Morenon (1977b) drew on the work of rural sociologists to examine the role of the rural component in regional (Chaco Basin) development. Others, primarily Allan and Broster (1978) and Ebert and Hitchcock (1980) used spatial analysis models developed by geographers, and their papers are characterized by direct application of these models to the Chaco system.

In time, the geographic models, especially those based on central place theory, were "re-modeled" to make them relevant to a number of anthropological concerns and situations. Carol Smith's (1976) regional analysis work gave Winter (1980) an opportunity to apply several spatial analysis models to Chacoan data. Increasingly, Chacoan archaeologists have focused attention on more economically-oriented models, particularly those based on redistribution. There are several variations on this theme including those by Marshall et al. (1979), Judge et al. (1981), Tainter and Gillio (1980) and Powers, Gillespie and Lekson (1983). Stuart and Gauthier (1981) have drawn on several of these sources in their summary of the Chacoan system. In addition, there have been more specific considerations of redistributed products, such as the ceramic redistribution studies by Toll, Windes and McKenna (1980) and Toll (1981).

Not all of the research cited above has produced specific models for explaining Chacoan cultural development. A review of these sources is appropriate, however, because they represent the range of hypothetical constructs offered to explain the emergence and function of Chacoan outliers and roads. Some familiarity with this material can also be helpful in making recommendations for future research.

Morenon's (1977b) investigation of the North Road led to the discovery of several sites associated with that roadway. Because the North Road appeared to connect two large Chacoan "urban" centers (Chaco Canyon and the Salmon-Aztec group), the presence of smaller "rural" sites between the two centers afforded Morenon an opportunity to consider rural-urban relationships in the Chaco Basin from the mid-eleventh to early twelfth centuries. He was specifically interested in "an examination of the rural component of the region as a contributor to the urban component..."(Morenon 1977a:27). Analysis of survey data resulted in defining two classes of rural road-associated sites--"small Chacoan settlements" and "small settlement or activity areas." These equate fairly closely, at least in the northern San Juan Basin, with Loose's (1979) production sites and transportation sites. Morenon concluded that the smaller sites predated the small Chacoan settlements, but that road construction and small site settlement were coincidental. The Chacoan settlements were located in specific ecological niches which could support permanent populations. Morenon believed that the North Road was laid out and constructed as a single unit, and ceramic data suggested that road use persisted after associated sites were abandoned.

Morenon noted that the establishment of the North Road coincided with major building projects in Chaco Canyon. This suggested to him that the road may have facilitated migration into Chaco Canyon from hinterland areas, a process characterizing many rural-growing-urban center situations. At some point the process may have been reversed and the rise of the urban centers on the San Juan and Animas Rivers could be attributed to emigration "of young individuals from Chaco Canyon" to these centers (Morenon 1977b:30). Morenon (1977b:30) notes that such a shift could have had serious implications for integrated regional development as the Chaco Canyon center had "less and less ability, to control the dispersed settlements...." In addition to facilitating travel between rural areas and urban centers, Morenon (1977b:28) commented that a strong argument for road building could be based on the need to minimize subsistence uncertainties. The economic aspect of road building and use tends to dominate most of the other explanations proposed for the Chacoan road network. The work by Ebert and Hitchcock, though concerned with regional social interrelationships, began this shift toward focusing on economic aspects.

The tentative conclusions on spatial interaction and Chacoan social systems reported by Ebert and Hitchcock respectively in their 1973 field reports were refined that same year in a paper, "Spatial Inference and the Archaeology of Complex Societies" (Ebert and Hitchcock 1973), which was published in final form in 1980 (Ebert and Hitchcock 1980). In the 1980 paper they employ geographic models "to gain further insight into the problem of Chaco Regional social structure" (Ebert and Hitchcock 1980:186). Because the major focus of their field work was on Chacoan roads, they chose transportation models to examine "relationships between measures of network configuration and other aspects of the social and physical landscape" (Ebert and Hitchcock 1980:177).

Following Kansky's (1963) conclusions that "more developed networks have more vertices, shorter edges, more terminals, and fewer circuits" (Ebert and Hitchcock 1980:180), Ebert and Hitchcock turned to Garrison's (1960) "Degree of Connectivity" to obtain some measure of network development. In brief:

"Degree of Connectivity = L*/observed number of routes
L* = m(m-1)/2
L*: maximum number of routes that could exist between nodes of network under study, taken as a value of 1.
m: # of places in network

This measure bears a relationship to the balance between over-the-road costs and the cost of constructing transportation facilities. If unit over-the-road cost is low and investment cost in facilities is high,...a network will be little-connected or 'underdeveloped.' Conversely, if investment cost is low and over-the-road cost is great, the system will exhibit a higher connectivity" (Ebert and Hitchcock 1980:184).

Garrison, as well as others, had determined that there was some correlation between network connectivity and economic development. By using Garrison's method of connectivity determination on Chacoan road data (an "idealized" Chaco Canyon network map was constructed from the 1973 survey data), Ebert and Hitchcock hoped they could deduce economic development and by extrapolation the social level of complexity of Chacoan culture in the eleventh and twelfth centuries AD.

The results suggested "a situation in which over-the-road costs were relatively low and investment in facilities high" (Ebert and Hitchcock 1980:192), a configuration typical of the underdeveloped extreme in a continuum of economic integration where "transport facilities convey high volumes of traffic or large amounts of bulked goods" (Ebert and Hitchcock 1980:192). Classified as "dendritic," this transport arrangement is characterized by flow between only the highest-order centers which draw on smaller local centers to the exclusion of other centers. Modern dendritic systems, marked by unregulated and exploitive traders and no price setting markets, produce powerful monopolies. Applying this to the Chacoan situation, Ebert and Hitchcock (1980:196) proposed that:

"Social and economic organization during the period that produced the roadways was of the form of an administrative bureaucracy that regulated intensive agricultural forces in and around densely populated urban centers. Tied economically to these centers was an outlying and more dispersed population of dry agriculturalists, hunters, gatherers and resource suppliers integrated with larger centers not by market or kinship ties, but rather through the entrepreneurial efforts of 'businessmen' operating outside the regulatory bonds of administrative power. That administrative and entrepreneurs were the same people, as seems to be the case today, is not discounted."

Bulked goods, including foodstuffs, in this system were intended for urban centers in Chaco Canyon and not for regional redistribution.

Ebert and Hitchcock argue persuasively that explanations of complex social systems must be regional in scope and include small sites in the "hinterlands." However the "Chaco roadway network" they used to determine degree of connectivity is for the most part a Chaco Canyon roadway network with connections to only a limited number of outlying communities. Comparison of the results of this study with a similar analysis of the regional system, as now known, might reveal whether the Canyon road complex was a microcosm of the greater Basin system or something different. In this context, it should be noted that Loose (1979:361) has commented that the transport "pattern" in Chaco Canyon "seems to continue outside the canyon." The Ebert and Hitchcock study was valuable because it, more than any other, focused on transportation routes and was limited geographically to the regional core.

Application of the Christaller model, a geographic model based on central place theory, by William Allan and John Broster in 1978 offered a more regional perspective on Chacoan roads and nodes and alternative views on cultural development in the Chaco Basin. Utilizing extant data on outliers and road segments, Allan and Broster proposed the existence of two levels of "centers" in the Chaco Basin: an A Center, Chaco Canyon, and B Centers, central places of a lower order. Two types of B Centers postulated (though not fully described) are probably equivalent to Loose's (1979:361) "transportation sites" and "production sites" and to Morenon's (1977b:4, Figure 2) "small Chacoan settlements and small settlement or activity areas."

When plotted, B Center locations showed a mean distance of 10.02 miles between sites (19 sites) with a standard deviation of 3.2. This deviation tentatively was ascribed to "the discontinuousness of soil and moisture conditions suitable for exploitation by a horticultural society" (Allan and Broster 1978:6). Locational data when displayed in a planimetric representation and taken through a series of abstracted levels ended with a Christaller hexagonal pattern. Allan and Broster (1978:7) concluded that "a redistributive network was indeed operating within the San Juan Basin during the Chacoan times."

The premise that regional disparity in San Juan Basin resource distribution stimulated exchange (propounded by Ebert and Hitchcock, Allan and Broster, and others) was examined more thoroughly by Joseph Winter (1980) who contended that in some cases population

survival in the Basin was dependent on redistribution of goods. (A basic alternative for population survival under such circumstances was migration, an alternative that often characterized Anasazi culture growth.) Redistribution of some services and the transmission of information was also recognized as an important factor in this process. Like Morenon, Winter had an opportunity to look at redistribution from a reversed perspective. He viewed the center from the "hinterlands" when he sought to explain the presence of sites in a marginal Chacoan environment, a location where permanent survival was deemed impossible without some form of exchange. Postulating that survival would have been possible through articulation with other groups in more suitable environments, Winter turned to regional energy exchange models proposed by Carol Smith (1976) to interpret prehistoric occupation of certain zones within the Chuska Valley on the western limits of the San Juan Basin. This area contained several Chacoan outliers and some evidence of roads. Smith (1976:12-13) considered a society's economy to include not only subsistence technology but the institutions and places that are involved in energy exchange. She notes, "Because we view exchange as a major articulating feature of an economy, we recognize distance and relative location as fundamental environmental variables" (Smith 1976:12-13).

Winter reviewed four of Smith's energy exchange systems: simple extended network, bounded extended network, solar central place, and dendritic central place. Concluding that the Chacoan system was more complex than a simple extended network, Winter evaluated the remaining three systems for applicability to the Chaco area. He states: "Based on the hypotheses of Judge (1979), Grebinger (1973), Martin and Plog (1973), Cordell (1979a, 1979c), Loose (1976), Lyons and Hitchcock (1977) and others, it is apparent that the Chacoan culture possessed many of the features of a dendritic exchange system" (Winter 1980:507).

The dendritic central place exchange system, characterized by open-ended, linear, hierarchical linkages without horizontal competition, may have redistribution as an important element. Typically such systems develop in colonial or neo-colonial contexts with a centralized market economy. Winter observes, however, that there is no evidence for militarism, tribute organization, or corvee labor, all aspects of colonialism. Chacoan roads in this exchange system "could have channeled the goods and labor to and from Chaco Canyon, which was the urban controlling center" (Winter 1980:507).

Roads would have served a similar function in a solar central place system, but Winter tentatively rejected this type of network because the spatial arrangement of Chacoan outliers "constrasts sharply with the classic solar structure" (Winter 1980:506). This classic structure consisted of a hierarchy of middle- and low-level centers symmetrically arranged in circles or hexagons around one main urban center. Each low-level center was positioned near the center of a "tributary hinterland." There was no competition between centers at low or middle levels as all were linked vertically to a single large center. Most solar central place networks were closed, self-sufficient systems, but exchange could occur between distinct solar systems.

Bounded extended network systems were simpler than solar or dendritic systems because the hierarchy of centers was limited to one major nodal center supplied by surrounding local units. As in other systems, these major centers were controlled by an elite segment of the population which supervised redistribution. In Winter's scenario (if this type of system had typified the Chacoan area) outliers such as the Hogback Site in the Chuska Valley could have served as major nodal centers.

Allan and Broster's network research was intended as a pilot structure for guiding future fieldwork, in this case the PNM-HPB project. Loose's interpretive influence is evident in the results of both studies, particularly in the Research Design he prepared for the PNM-HPB project publication. Though an interpretive model is not specifically presented in the Research Design or in the body of the report, an explanatory scheme for the Chacoan Phenomenon based on the redistribution of foodstuffs can be extracted from the document. In this construct food limitations in Chaco Canyon, beginning possibly as early as the late Archaic and intensifying through time, eventually dictated population movement out of the Canyon, importation of food into the Canyon, or both. Because many areas surrounding the Canyon (especially to the south and west) had more productive soils and dependable rainfall, surplus food could be produced for transport to Chaco Canyon. Loose (1979:360) argues that in time the central Canyon became "a redistribution center centrally located to productive agricultural areas." To ensure efficient and dependable redistribution, "outlying colonies" (outliers) were established in food production areas as "organizational and exchange nodes." These local centers included a multistory "public" structure and great kiva constructed in Bonito Phase architectural style and small Hosta Butte Phase style domiciliary structures. According to Marshall and his co-authors (Marshall et al. 1979:337), the "populace lived in the small structures (Hosta Butte Phase) and used the larger structures for storage, and for periodic sessions of special tasks related to public obligations and decision-making processes. These tasks were probably ceremonial, economic and administrative in nature." The administrative and storage aspects of the outlying colonies and the central Canyon are stressed in this "multi-level food distri-

buting network." To further ensure administrative control and timely redistribution of food, roads linked outlying production areas with Chaco Canyon. Even more efficiency in transport was made possible by the development of "transportation" outliers directly associated with roads and presumed to have been established for facilitating the movement and not the production of goods. Based on field data it was possible to show that:

Two basic types of outlying Chacoan sites may be functionally different, morphologically different, and spaced relatively to each other by two discreet mean distances:

a. Production sites--associated with good soils, relatively high amounts of available moisture, modern communities, Basketmaker II communities, and areas of relatively long growing season. Mean spacing of about eight miles. High local site densities.

b. Transportation sites--not so strongly correlated with the above characteristics, associated with roads, mean spacing of about 12 miles, and low local site densities.

Judge et al. (1981), somewhat more cautious in their reconstruction of Chacoan prehistory and economic development, analyze the possible beginnings of a redistributive network in the Chaco and San Juan Basins. Like Marshall et al. (1979), they cite climatic and edaphic factors for culture change, stressing "high variability and low predictability in the spatial and temporal distribution of precipitation" (Judge et al. 1981:67) as creating food shortage stress. Initially, the effects of localized shortages were resolved by out-migration or reciprocal exchange through broad-based alliance networks. Eventually, however, increasing population and varying moisture conditions stimulated cultivation of high risk areas and communal pooling, storage and redistribution of foodstuffs among the contributors. "Central place" sites emerged in a number of environmentally favored zones--confluence areas of tributaries to the Chaco "River"--and villages located on the tributaries and proximal portions of the Chaco were "controlled" by a central place site. Expansion of the redistributive network was initially along each watershed.

A Canyon-wide redistributive network is postulated for the early tenth century, and within another hundred years Chaco Canyon may have emerged as a "central place of a different magnitude within the San Juan Basin as a whole" (Judge et al. 1981:88). This expanded network "comprised the central Canyon, and perhaps 50 or more 'satellite' communities dispersed throughout the San Juan Basin and connected to Chaco by a system of roads" (Judge et al. 1981:88). The expansion of the system may have been through colonization of outlying areas from Chaco Canyon or by incorporating outliers that had evolved as central places in their own regions along developmental lines similar to tenth century sites in Chaco Canyon.

This latter concept is examined by Tainter and Gillio (1980) who propose that the El Rito outlier in the San Mateo Valley may have been a local system based on a hierarchically managed economy that was brought into the regional Chacoan system. Their reconstruction of this regional system parallels others reviewed above in that it is based on redistribution of goods through hierarchically organized centers. Like Allan and Broster, and Marshall and his co-authors, they postulate a three-level settlement hierarchy, but with a few interesting variations. First-order centers are the Classic Bonito towns in the Canyon and possibly the large outlying towns of the Aztec and Salmon Ruins. The Chaco Canyon center in this case is not the Canyon complex of towns but the towns themselves. Second-order centers are the "remaining outliers" (presumably all outliers smaller than the Aztec and Salmon Ruins) and third-order centers are not centers at all but "localized population aggregates occupying small agricultural villages" (Tainter and Gillio 1980:104). Second-order centers were linked to Chaco Canyon "by a network of roads, leading like spokes to the center" (Tainter and Gillio 1980:102). Their diagram of "Exchange Hierarchies in the Chacoan Interaction Sphere" (Tainter and Gillio 1980, Figure 7) shows exchange flowing in both directions between first- and second-order centers and in both directions between second- and third-order centers. In addition, goods flow between third-order populations, a condition probably characterized by reciprocal exchange as discussed by Judge. Roads are not predicted to be found connecting second-order centers, but if found would not be "on the level of the road network that has already been documented" (Tainter and Gillio 1980:104). If such roads were found (and Tainter and Gillio cite a possible example of roads connecting the San Mateo, El Rito, Kin Nizhoni, Haystack and Andrews outliers) they "probably functioned as local distribution roads, serving to accumulate or disperse the materials transported over the main roads" (Tainter and Gillio 1980:104).

Powers' (in Powers, Lekson and Gillespie 1977, published as Powers, Gillespie and Lekson 1983) postulated "Chacoan regional system" is a thorough reconstruction of the evolution of Chacoan culture that follows the basic tenets of other Chaco Center models by noting the emergence of a fairly sophisticated exchange system in the Chaco Basin by the early tenth century and the ultimate expansion of this system in the twelfth century to the limits of the Basin and in some cases beyond. Like other researchers, Powers proposes a hierarchical site pattern with a regional center (at least until the early twelfth century) in Chaco Canyon. Following Judge (Judge et al. 1981) he sees the system emerging first in Chaco

Canyon during the early tenth century with a settlement hierarchy evolving through the implementation of exchange networks designed to reduce localized food shortages. Within a century the need to supply Canyon inhabitants with a range of goods had resulted in the extension of the exchange network throughout the Chaco and San Juan Basins. This network was marked by Chacoan communities (outliers) in a variety of Basin and extra-Basin environments and by roads linking these communities to Chaco Canyon.

His familiarity with outlier and road data allows Powers to draw some conclusions about zonal road systems, make some distinctions in "sub-systems" and refine the relationship of some roads to particular towns in Chaco Canyon. It is implied that the core of the Chacoan road network consisted of four major roads extending out from Chaco Canyon to relatively widely spaced resource areas. Resource exploitation was enhanced by the fact that these major roads traversed a number of Chaco Basin environments before reaching the "ecologically diverse Chaco Basin edge areas" (Powers, Lekson and Gillespie 1977:148). Each of the major roads passed near a number of Chacoan outliers, and Powers guesses that some variance in the normally quite linear roadways resulted from linkages to outliers not on the direct route of the road. Major roads appear to have been routed to particular zones on the Basin edge, at which point road segments take on a "more dendritic pattern, since the spatial distribution of great house communities at the basin perimeter is generally perpendicular to the angle at which roads approach the basin edges" (Powers, Lekson and Gillespie 1977:30)

Actually, this dendritic pattern characterizes two major roads (Powers' South and West Roads) before reaching the Basin edge, but Powers' Southwest and North Roads had no known branches. "Here the spatial relationship between roads and greathouse communities might be characterized as 'in series' since communities occur in sequence along the road route" (Powers, Lekson and Gillespie 1977:30). Powers notes, as others have, that there is little evidence for roads connecting outliers on different major links, thus reinforcing the apparent "separateness" of the major roads.

Though road segments increase in number near the Basin edge, the tie to Chaco Canyon is by one major road. This raises some interesting questions with regard to the reported "parallel roads," particularly on portions of the North Road. Powers believes that these major roads may well be directly associated with specific towns in Chaco Canyon, and he lists Penasco Blanco, Pueblo Alto, Pueblo del Arroyo, Pueblo Bonito and Una Vida as possible end points (or conversely departure points) on major roads. Most of these towns are located at natural entries to the Canyon. It is probably no coincidence that three of these towns (Penasco Blanco, Pueblo Bonito, and Una Vida) were identified by Judge and others (1981) as early tenth century "central places"--with tributaries of the Chaco joining the principal drainage near these Canyon entry points.

The potentially early development of these towns (or some of them) and their location in Chaco Canyon gave them "secondary hierarchical level" status in a "multiple level settlement hierarchy." It is proposed that the perquisites of this status level included dominance "over individual outlying road systems and their associated communities" (Powers, Lekson and Gillespie 1977:31). More specifically, "they may have controlled movement on roads and supervised canyon-outlier interaction, including resource exchange as well as political and ceremonial interaction" (Powers, Lekson and Gillespie 1977). Powers tentatively suggests that two towns, Pueblo Bonito and Chetro Ketl, may have stood at the "apex" of the hierarchical system. Their size, long sequence of development and occupation in the Canyon and their location (a "probable interchange position with respect to all incoming roads") are factors supporting this interpretation. If they were at the apex they functioned to control the entire regional system. Powers makes the provocative suggestion (originally tentatively considered by Morenon) that late development of the two extra-canyon towns, Salmon and Aztec, and the concomitant establishment of many northern outliers could be interpreted as a late shift of power in the Chacoan regional system from Chaco Canyon to centers on the San Juan and Animas Rivers.

Though Powers' major road systems were characterized as largely separate and in a sense "closed" networks (an hypothesis that tends to get some support from resource-source studies, see Powers, Lekson and Gillespie 1977:148-149), contact between outliers of different road systems seems likely. Powers does not believe that this contact was formalized by interconnecting roads. Towns within Chaco Canyon do appear to have been connected by roads, and Powers briefly notes intra-Canyon roads. These Canyon linkages may be replicated at outlying sites since replication of Canyon settlement pattern at outlying sites is proposed by Powers; if so, this would support Powers' hypothesized three-tiered settlement pattern in the Canyon.

Powers' suggestion that areas to the north of Chaco Canyon may have been brought into the regional system late in the Chaco exchange network development are tentatively supported by ceramic studies made by Toll, Windes and McKenna (1980). This research focused on shifts in ceramic exchange within the Chaco Basin, particularly shifts in source areas for ceramics imported into Chaco Canyon. Using temper, design styles and iron impurities in clay to identify source areas, Toll and his co-researchers posited that during the Early Bonito Phase some ceramics

in Chaco Canyon "originated in areas...along the southern periphery of the San Juan Basin" (Toll, Windes and McKenna 1980:97). By Classic Bonito Phase times ceramic sources had moved from areas to the south of Chaco Canyon to the Chuska Valley west of Chaco Canyon. By the Late Bonito Phase a number of decorated wares were being imported from locales to the north of Chaco Canyon, though Chuskan culinary wares probably remained the largest group of imported wares.

Toll (1981), using much of the same data analyzed for the above study, more closely examined the role that towns may have played in a Chacoan redistributive system. He proposed that towns on roads at entry points to Chaco Canyon such as Una Vida, Penasco Blanco and Pueblo Alto, and perhaps all towns in Chaco Canyon, may have functioned as locales for periodic exchange markets. He pointed out that markets in a redistribution network have the advantage of providing a non-coercive mechanism for movement of "large quantities of goods to central points for redistribution" (Toll 1981:111). Market exchange systems are usually characterized by complementary exchanges, periodic meetings and participation by specialists in production and marketing.

If ceramics were exchanged and if certain towns functioned as market places in Chaco Canyon, it was expected that the ceramic inventory at those sites would differ from ceramics at smaller habitation sites. More specifically, a town ceramic inventory should be characterized by a larger number of source areas, more diverse vessel forms and greater quantities of specialized vessels for storage and transport. Working within the limitations of the ceramic data base available for study, Toll analyzed pottery from Pueblo Alto and site 29 SJ 627, a long-lived Chacoan village, to assess the presence of specialized production and differential distribution of non-local ceramics at each site. His results indicate that, in general, ceramics at Pueblo Alto came from longer distances and were possibly specialist-produced. There was "less diversity in vessel form; more diversity in identified temper sources; and less diversity of vessel form within the identified long distance temper group" (Toll 1981:115). At the village site there were greater numbers of vessel forms and more bowls within the defined long distance group.

Though the results were not totally conclusive, Toll could find no "glaring contradictions" in a regional center model. While redistribution was partially demonstrated, Toll (1981:115) did caution that "any specification of redistribution mechanism is very tenuous."

Ancillary Studies

Several persons researching Chacoan roads or road-related sites have, in the course of their work, investigated ancillary aspects of road construction or use. Results of this work have tended to support rather than alter basic interpretation of the roads and the road network. Three of these studies are briefly summarized here.

With the recognition in 1973 that some Chacoan roads did extend for considerable distances beyond Chaco Canyon, Randall Morrison made a preliminary analysis of road alignment methods and techniques. Using the Remote Sensing Project survey data, he determined that line-of-sight observations were sufficient for roads extending no more than a mile. On longer roads prominent topographic features, particularly those on horizon lines, were used. He notes that such roads could "be surveyed by use of back and front sights from high ground to maintain the alignment on far horizon topographic features. The Ya'a-Chaco road is probably the best example of such a system" (Morrison 1973:38). Changes in road alignment were often angular, producing "doglegs," a feature that Morrison believed supported his theory that road routes were surveyed. He recommended that the use of celestial alignment be investigated, noting that several roads extending north from Pueblo Alto were on a "long-line 10 degrees north heading" that could be a "backsight for celestial features in the southern sky" (Morrison 1973:39).

Accepting the basic premises of a goods redistribution system as outlined by Judge and other Chaco Center personnel for the Chaco Basin, Dwight Drager (1976:6) proposed that the "key to a system of this type" was the ability to transmit information so that goods (particularly foodstuffs) and people could be moved in a short period of time. The most reasonable solution to this need was a signalling system. Commenting that "one of the fortunate things about the San Juan Basin is that visibility is nearly unlimited" (Drager 1976:6), and noting that surveys had recorded a number of mesa-top, non-habitation architectural features, Drager proposed that a signalling communication system had been developed for the San Juan Basin. He plotted 23 possible observation and signalling points (primarily habitation sites) in a swath extending from the Crownpoint area north to but not including Huerfano Mesa (Huerfano Buttes). Field checking revealed 56 visual connections or links between these sites with a high of nine links at one site and a low of a single link at two sites. "This low incidence of single links means that there is some degree of redundancy in the system; that is, there is more than one path along which the message can flow" (Drager 1976:10). When he included shrines in his study, Drager determined that almost all shrines (9 out of 10) had visual connections. More importantly, he found that "without the shrines, all the outlying pueblos lose visual communication with the central canyon except for Kin Klizhin and Pierre's Site" (Drager 1976:11). Shrines within the Canyon area, then, were crucial for a visual communication network. The visibility of shrines in a signalling system was demonstrated when

Thomas Windes predicted and then located two shrine sites necessary for visual communication between Pueblo Pintado and the central Canyon. Drager also discovered that in a few instances lines-of-sight for visual communication paralleled known Chacoan roadways, the Fajada Butte Gap-Kin Ya'a connection being the best example. The data fairly conclusively showed that visual communication between Chacoan communities in the Chaco Basin and probably the San Juan Basin was not only possible but had probably occurred. Drager did not speculate on the management of such a system, but implied that it would have been controlled from Chaco Canyon.

In 1977 Pierre Morenon conducted several experiments in Chaco Canyon "to determine the degree to which prehistoric roads could have minimized energy expenditure in travel and transportation into, within and out of Chaco Canyon" (Morenon 1977a:3). A number of walking exercises were conducted on various surfaces and on different slopes with and without weights. A respirometer was used on the test subjects to measure caloric requirements for the exercises under the varying conditions.

In addition to verifying the expected--using roads saves energy--Morenon drew some interesting conclusions. He noted that there would have been a significant energy saving even if roads were used only for traveling and not transportation of goods. This led him to conclude:

"Thus, one cannot assume that prehistoric roads implied that transportation of goods was the underlying reason for their construction. A highly mobile population could benefit from the construction of roads even if these roads were not generally used for transporting goods" (Morenon 1977a:4).

Further investigation of the requirements for travel as opposed to transportation, especially the transportation of heavy items, led to the judgement that roads for travel would minimize distance but roads for transportation would minimize slope. For example, ramps rather than stairways would probably be constructed for the movement of heavy items. At the same time, labor investment in minimizing slope could be considerably greater than in minimizing distance, an investment that would require pay-off in the value of transported goods. Maintenance investment would have been equally important and road location (avoiding areas with aeolian accumulation) and design (wide roads may resist aggregation of loose sediments longer than narrow roads) could have been critical factors. Morenon concluded that there was good evidence that Chacoan road architects were concerned about road construction and maintenance costs, and that roads were probably predominantly used for travel and transportation of "light items."

Summary of Interpretive Approaches

The concept of what constituted a Chacoan road came somewhat earlier than the perception that there was a Chacoan road network. It would be a mistake, however, not to give credit to early researchers for not only recognizing and describing Chacoan roads but also for realizing that some kind of road system probably existed in the San Juan Basin.

When roads were "re-discovered" in the early 1970s, work was focused again on defining road attributes rather than the road system or network, though this emphasis changed rather quickly. By the early 1970s three general types of road attributes were recognized. These included (1) basic morphological features such as linearity, broad and standardized widths, defined edges and prepared surfaces, (2) constructional features that defined the road or directly facilitated travel or use, and (3) features on or near roads that may not have directly facilitated travel or use but which were considered road-associated. Among the large group of constructional features were cuts through hills, ramps, stairways of various types, platforms, grooves and several kinds of borders or curbs. Features thought to be road-associated included rock circles, hearths, cairns and sites near or adjacent to the road.

Though the list of morphological and constructional features associated with roads has grown in the past decade, the basic attributes were known and described by Judd. Vivian and Buettner did slightly expand on features known to Judd, but delays in making the full range of their data public hindered the development of a useful terminology for roads and road-related features. Morrison (1973) was the first to compile a list of associated features and to define the terms he used, but this was done at a time when features associated with roads--like the roads themselves--seemed to multiply. Thus, there were "steps," "stairs," "stairways," and "staircases," as well as "hand and toe holes" or "hand and toe holds" (not all of these are Morrison's terms, but they do represent terms used since 1973).

A fairly complete Chacoan road feature inventory probably developed early and remained essentially unchanged because the greatest variation in road attributes occurred in Chaco Canyon, the initial focus of road studies and an area where roads and associated features are more visible. One could predict that if there were any major changes in or additions to Chacoan road attributes they would result from more intensive study of road segments outside of Chaco Canyon. Work to date in these areas, though limited, suggests that such changes or additions are unlikely. However, despite all the research on Chacoan roads during the past decade a standardized terminology for even

the most frequent and basic construction features did not develop. Early definition of terms using Morrison's list would have helped resolve some imponderables such as Irwin-Williams' (1973b:14-15) reference to ditch-bordered roads. The information presented in Chapters 5 and 6 of this report should help to correct this problem.

In contrast to the early and fairly complete delineation of road segment attributes, definition of the attributes of the Chacoan road network progressed more slowly. This slowness was the result of a number of factors, the most important probably being the initial concentration of research in Chaco Canyon and its immediate vicinity. Survey on both the North and South Roads between 1971 and 1974 did establish that Chacoan roads were not confined to the Canyon area, and early references to Chacoan roads in other parts of the San Juan Basin hinted strongly at a Basin-wide system, but the extent and characteristics of such a system had not been well documented. Other factors included the difficulty of precisely defining extra-Canyon roads on the ground and a reluctance by some to accept the existence of Chacoan roads. (Flynn was not alone in questioning Chacoan roads, much less a Basin-wide road network.)

The ability to delimit and describe the road network changed with the vastly increased use of aerial imagery and aerial reconnaissance. This procedure resulted in the identification of many "linearities" or "linear features" in and near Chaco Canyon and within the San Juan Basin. These discovery techniques, particularly the use of aerial imagery, were not without their difficulties. Two serious and related problems were the over-identification of linear features as road segments, and the failure or inability to adequately ground verify linearities labled as Chacoan roads. The failure in some instances to distinguish clearly between positively identified Chacoan roads and possible Chacoan roads within the San Juan Basin prompted serious questioning about their reality.

Nevertheless, a sufficient number of segments were ground verified to confirm a rudimentary road network in the Basin. On the basis of available data several road network attributes can now be distinguished. Probably the most basic and easily defended network attribute is that Chacoan roads link sites (site size may vary considerably) and these sites are characterized by Bonito Style architecture. Sites without Bonito Style architecture may occur along roads but they do not occur at road end points. Other criteria for road segment termini have been proposed but architecture is the most consistently verifiable criterion. However, it is true that end points have not been established for all known road segments, suggesting that some roads may have terminated in resource zones and not always at sites. (One of the best examples of a leading essentially "nowhere" is the Penasco Blanco to Ahshislepah Road--the Vivian and Buettner West Road--which appears to end at Ahshislepah Canyon.) (Editor's Note: See Chapter 11.) On the other hand, more termini are known than are not known, and this attribute is probably sound.

Discounting unverified conclusions of both early and recent observers that Chacoan roads extend south into Mexico or east into the Rio Grande Valley, the Chacoan road network appears to be confined to the greater San Juan Basin. Chacoan communities outside the Basin may have linking roadways, but field studies so far have not shown this to be the case. Apparently, there was a road building-labor expenditure threshold that if surpassed would not equal the benefits of network energy exchange, and this threshold may have equated with the perimeter of the San Juan Basin. This would not preclude the establishment of Chacoan outliers beyond the threshold limits, but it could dictate against extending roads to colonies outside the Basin. This raises the as yet unresolved but important question of how much actual construction was involved in emplacing the road network.

Based on some fairly reliable evidence, most archaeologists have identified Chaco Canyon as the center or hub of the network, thereby implicitly conveying the idea that it was a network with a center. When outliers are plotted they do essentially ring Chaco Canyon except to the east and northeast where virtually no outliers have been located. The concept of a network center has been furthered recently by the postulate that late in Chacoan cultural development there was a shift in "power" from Chaco Canyon to town sites on the Animas and San Juan Rivers in the northern San Juan Basin. This possibility has interesting implications for exchange system models proposed for the Chaco. Because Chaco Canyon lies approximately in the center of the Chaco and San Juan Basins several studies have compared the Chacoan network with the classic solar exchange system. A geographic shift of the central place would presumably alter much of the structure of the network in the classic pattern. On the other hand, though the term central place implies a location central to all contributing nodes, various other models with central places are not constructed on this locational concept.

Another network attribute is its function not only in linking Chacoan sites but also in tying sites in Chaco Canyon to resource areas. This function was recognized quite early when it was thought that roads led to quarries or timbering zones. Though roads are still thought to be routed to resource areas, Chacoan communities (outliers) exploiting these resources are now expected at the road end points within a resource zone. A more recently defined elaboration of this system attribute is the branching of roads as they near the edges of the Chaco

Basin. This dendritic pattern is explained as the result of tying into many outliers in the more environmentally diverse zones at the Basin perimeter. The documentation of outlier-road relationships, based on accelerated outlier research, has probably been the most significant recent clarification of this system attribute. In some ways, knowledge of Chacoan prehistory has been augmented more by increased knowledge of Chacoan outliers than by information on roads. There has been a progression from predicting road segment locations between a few known outliers to predicting outlier locations on known roads.

Two other network attributes are less securely established. There is some evidence (primarily dating by ceramics) that the road system may have originated by linking sites south of Chaco Canyon to towns in the Canyon proper and then, over a period of approximately a century, the network expanded to the west and ultimately to the north. If this were how the network developed it suggests that exploitation of the Chaco and San Juan Basins was gradual and not a regional scheme devised and implanted over a short period of time. Support for this theory may come from another possible system attribute, zonal variation in road patterning. Again, the evidence is slight, but it appears that roads going south from Chaco Canyon branch shortly after leaving the Canyon and in some cases continue to branch or divide, whereas roads extending north from Chaco Canyon do not branch or divide until reaching almost the edges of the Basin. (The roads leading north and east from Pueblo Alto, with the exception of the North Road, are discounted here because it is probable that none go beyond the Escavada Wash and are, therefore, considered to be within the general confines of Chaco Canyon.) Physiographic and edaphic factors may explain this zonal variation. Nearby suitable resource areas were relatively plentiful to the south of the Canyon and this area had been inhabited continuously for a long period of time. Road planning may have entailed determining which areas and resident populations could be exploited most easily and profitably. The country to the immediate north of Chaco Canyon did not contain as many resource niches nor population centers and road planning here appears to have been directed towards moving across the area to reach more productive niches at the Basin edge. In fact, many of the sites known to the north of Chaco Canyon are road-associated and many are "transportation" type sites. It is difficult to explain why Pierre's Site, a presumed production site on the North Road, was ever established considering the resource potential further north along the San Juan and Animas Rivers. This type of site may be critical in explaining the development and use of Chacoan roads.

Two other potential attributes will require more investigation, but could have some important implications for the network if they are verified. Drager's (1976) preliminary conclusions that Chacoan roads might be only one aspect of a broader communication system within the San Juan Basin could imply multi-functional roads (a concept proposed by Obenauf), and possibly greater control of the system from one central place. Another possible network attribute, as yet poorly defined, is the presence in some areas of double (and in one case possibly even quadruple) parallel roads. The best examples of this feature are on the North Road (see Chapter 6), though some double segments have been reported for the South Road near Casa Patricio. There is no good evidence to support non-contemporaneity as an explanation for parallel roads, though eventually this may account for them. If double roads do exist, and if they are contemporary, the implications for an economic explanation of the road network are considerable.

Field work at a number of important sites within and on the edges of the San Juan Basin in the 1920s and 1930s (Jeancon 1922, Roberts 1932, Martin 1936, Morris 1939) led to the recognition that there were a number of sites throughout this area that were characterized by architectural traits most commonly associated with large town sites in Chaco Canyon. The architectural tie (and to a lesser degree the ceramic tie) to Chaco Canyon was realized and some type of connection was acknowledged, but the process of articulation and the role these sites assumed with respect to one another was never fully explored. The extent and characteristics of this regional development, frequently referred to now as the Chacoan Phenomenon, have become better known only within the past decade. This process has depended in part on roads research. As Chacoan roads have been recognized not only as linking Bonito Phase sites, but also as a cultural feature uniquely associated with these sites, they have become a crucial link in developing explanatory models for the evolution of the Chacoan Phenomenon.

The interpretation of Chacoan roads and the road network, therefore, has closely paralleled the development of explanatory models for the growth of Chacoan culture. These models have taken two basic forms: those based on growth resulting from the impact on local cultural systems by a pochteca-like trading system introduced from Mesoamerica, and those that have seen growth as a more locally induced process triggered by changing environmental conditions. Both had been proposed in one form or another before much roads data were available, but in more recent years the environmental thesis has accounted for the majority of models. Ultimately, both explanatory schemes are based on economics and more specifically on the transport of goods. In essence then, information on Chacoan roads and the road network has been used to support existing

basic explanatory models and not to develop explanations for roads per se.

The preceding review of a number of these models has pinpointed some basic similarities and differences. As noted above, emphasis has been on viewing Chacoan cultural growth as an adaptation to environmental change. The marginal nature of much of the San Juan Basin for agriculture and the impact on agriculture of unpredictable moisture patterns, coupled with an increasing population, made some form of subsistence exchange necessary by the tenth century AD, if not earlier. Models for Chacoan energy exchange have to a large extent depended on the structure of exchange models developed by geographers. Several early models were essentially direct applications of geographic constructs, but more recently variations on the primary models have been developed to account for regional environmental and other peculiarities. Exchange involving redistribution of goods is the most commonly proposed type. Generally, foodstuffs rank high on the list of items thought to have been exchanged, but ceramics and lithics as well as other items have been cited as trade goods. Exchange of services is also mentioned in a number of models (for example, Marshall et al. 1979) but the type and nature of services are usually expressed only as broad categories (religious, administrative, construction, farm work, etc.).

There are, in addition, several other lines of basic agreement in these explanatory models. Most conclude that energy exchange within the Chaco region (and probably the San Juan Basin) involved tying Chaco Canyon to more productive zones near the perimeters of the San Juan Basin. Based on some general studies of edaphic and moisture conditions in the Basin, it has been concluded that Chaco Canyon could not have supported a large population, hence the need to import food from more productive areas. It should be noted, however, that no thorough study of agricultural potential in various zones, including Chaco Canyon, has been made. Loose (1979) has made some intriguing probes in this direction but considerably more work is needed.

There has also been a general consensus that links in the road network were vertical, tying outliers to the central Canyon, and not horizontal between outliers. While links might branch or converge dendritically, they moved vertically to Chaco Canyon. There is some vague evidence for horizontal linkages between outliers to the south of Chaco Canyon. If there are zonal patterns to the road network as suggested earlier, one might expect to find horizontal links to the south of Chaco Canyon and not to the north. This is certainly an aspect of the network that should be more intensively explored.

Though linkages in the network have mostly been interpreted as vertical, there is not consistent agreement on the patterning of these vertical links. Winter (1980) has provided the most comprehensive review of several possible exchange types and distribution systems (taken from Smith 1976) and has concluded that while a solar central place system might apply to the Chacoan situation, it is more likely that a dendritic central place system was in operation. System types in the models proposed by Allan and Broster (1978), Tainter and Gillio (1980) and Ebert and Hitchcock (1980) appear to be more solar than dendritic, though the actual pattern is not classic in form. System type in models by Judge et al. (1981) and Marshall et al. (1979) is more dendritic than solar. There is a need in the dendritic models to specify more precisely if the system is dendritic central place or bounded hierarchical. Network hierarchy has only been considered in any detail by Tainter and Gillio. This aspect of network exchange should receive more attention. The work by Powers, Gillespie and Lekson (1983) is an important move in this direction.

There is also disagreement on the form of redistribution. Some models, such as that proposed by Marshall et al. see most goods flowing into Chaco Canyon for use by resident populations with little movement of goods back to outliers. Judge et al. appear to favor complete redistribution with materials cycling through Chaco Canyon, but their concentration on the early development of Chacoan culture precludes examination of the network as it operated in the eleventh and twelfth centuries. Winter and several others have proposed that goods flowed into and out of Chaco Canyon on a regular patterned basis. The form of system management has been less considered than consistent. Whereas there is usual agreement that network control was created in Chaco Canyon (with a possible late shift to the northern San Juan Basin), the structure, organization and mechanics of network administration have had only cursory investigation.

In general, these models are quite similar, and they employ and interpret roads data in much the same way. Where differences in interpretation exist, they do not change the basic tenets of the models, which are economically oriented. Ultimately, there is a limited number of ways in which roads can be used for transport. Other aspects of the development of the Chacoan Phenomenon may figure more prominently in future model building. But there may be a need for caution. Road network data have provided an important element in these models, but this data "fit" has been so neat that there has been a tendency to unquestioningly assume a transport function for roads. Ebert and Hitchcock have employed transport models, and most of the geographers' models used assume transport as an aspect of the network. Some (for example, Toll 1981) have urged caution in proposing how roads functioned within the cultural system, but few have looked beyond transport. It may be time to re-read Morenon's (1977a) brief study on energy

expenditure and to reevaluate the full range of roadway use in the Chacoan culture system.

Chapter Summary

The purpose of this chapter has been to provide an historical perspective on past studies of Chacoan roads by identifying changes in methodological procedures and theoretical orientation through documentation of road research and summation of the results of road studies. A number of general conclusions can be drawn from these data that may be useful in formulating future research designed to identify, describe, interpret and mitigate Chacoan roads, road-associated features and, on a larger scale, the Chacoan road network.

Methods for identifying Chacoan roads have improved over the past decade largely as the result of the greatly increased use of aerial imagery. Imagery has been particularly important in areas of moderate to low relief, relief that characterizes much of the San Juan and Chaco Basins. But it has also been successfully used in Chaco Canyon and its immediate vicinity where high relief and abundant bedrock exposures have tended to make road identification easier. The use of equipment to enhance specific aspects of imagery does not appear to have contributed as much to road identification as has greater awareness of the need to consider time of day, season, altitude and flight angle during aerial photography. These points were made by Ware and Gumerman (1977) early in Chacoan road research, but they have not been consistently applied or tested by persons utilizing aerial imagery for road and network definition. The major drawback in using aerial imagery for identification has been the inability to ground verify feature presence or absence in some zones. Overall, the benefits have outweighed the problems.

Aerial reconnaissance has been an important tool in road identification as well, but its use has been more limited. This may be because reconnaissance flights normally have not been designed to produce good quality vertical imagery useful for future study. On the other hand, these flights can be used to obtain oblique imagery, which in some instances reveals more than vertical imagery, and more importantly, reconnaissance flights in light aircraft are a relatively inexpensive way to initially identify predicted road alignments and feature locations. Ware and Gumerman suggested that combined ground and aerial survey would reduce field time and costs, but few projects have fully developed this approach.

Though Obenauf has experimented with predicting road locations based on known road alignments and outlier positions, this is an aspect of road identification that has not been fully realized. In part this may be the result of the lack of a well-defined concept of what constituted the Chacoan road network and the very tentative status of road network models developed for the Chaco. Field investigation of network segments has been largely of the "shotgun" approach. The potential for prediction in road identification and interpretation is almost unlimited, however, and represents one of the most challenging and exciting aspects of road research.

As noted above, verification of road segments identified on aerial imagery has been one of the more serious problems confronting road research. The tendency to accept segment identification without ground checking has not only led to misidentification of some segments, but it has also curtailed road attribute analysis by reducing or eliminating the need to define and describe road attributes in areas away from Chaco Canyon. This has prolonged the tendency to view roads a few kilometers outside Chaco Canyon as vaguely defined footpaths rather than prepared roads. Because most Chacoan road segments are not obviously apparent on the ground, verification remains an important element in road research both to confirm the existence of imaged roads and to obtain additional attribute data. Two techniques used for road verification in areas where surface indications are minimal to missing--artifact density and distribution analysis, and subsurface testing--have had moderate to good success. Morenon's pioneering work in artifact distribution studies confirmed that higher artifact density could be expected on or near roadways. It should be noted, though, that this work was done on the North Road which may have had a greater transport function than other roads in the Chaco Basin; in addition, fewer habitation sites were present in the zone traversed by the North Road. "Artifact noise" in more densely settled areas, such as along the South Road, could potentially affect artifact density and distribution studies and reduce the effectiveness of this technique.

Subsurface testing for road verification was examined most thoroughly by Ware and Gumerman who found that this technique provided minimal to fair results in defining road beds and borders. Vivian and Buettner experienced similar results, although they were not specifically attempting to verify the presence of roads but rather were more concerned with delimiting road attributes. Brethauer's inconclusive tests may have resulted from misplacement of test trenches, but more likely his inability to define roadbeds in the trench profiles was the result of limited training in profile analysis. In all of the instances cited above, more conclusive data may have been employed to analyze profiles and surfaces. This technique undoubtedly holds promise for road verification work particularly in areas where a prehistoric road has been excavated into unconsolidated sediments. Although the value of particular techniques for verifying road segments may well vary from road to road depending on a variety of cultural and

natural factors, some form of verification remains essential.

One of the most serious current deficiencies in Chacoan road research is the almost complete lack of standardization in defining and describing roads, their associated features and major network elements. The problems range from continued inconsistencies in defining attributes of roads and road-associated features to the haphazard and confusing method of labeling road segments and identifying specific segments or groups of segments. (As a case in point, the term "segment" has never been defined.) In the initial stages of road research when small quantities of new data were being generated this problem was not as severe. However, as more models have been developed to explain how Chacoan roads functioned within Chacoan culture, a more precise definition of terms, system components and the total network has become imperative. Basic attribute definition is possible now and would ensure more precision in existing terminology. For example, ramps remain poorly described, double roads and "doglegs" have been reported as characterizing roads but have not been fully defined, and such features as "round roadside attractions" are only vaguely understood. Some simple method for segment and system designation should be proposed and tested (the Remote Sensing Project system appears cumbersome but could be modified).

Interpretive study of Chacoan roads has both contributed to and benefited from a regional perspective that has characterized Chacoan research over the past decade. Explanations for the Chacoan Phenomenon owe much to road study, but road study would be limited without a regional perspective. Initially, roads were an important factor, if not the most important factor, in the conceptual linking of several well known Chacoan sites (e.g., Village of the Great Kivas, Salmon, Aztec) scattered throughout the San Juan Basin. Shortly, roads became an important catalyst in outlier research and a strong motivation for locating additional satellite colonies in the Basin. Advances in road-outlier analysis directly contributed to the interpretation of major town centers in Chaco Canyon and in the northern Basin on the San Juan and Animas Rivers.

The conclusions drawn by Jeffery Altschul in his 1978 article, "The Development of the Chacoan Interaction Sphere," serve as a good measure of how road-outlier research has advanced explanations of the Chacoan Phenomenon. In this paper Altschul justifiably argues that Chacoan research in the late 1960s and early 1970s had been "focused on the unique characteristics of one area, Chaco Canyon" (Altschul 1978:109), and he suggested that only attention to Basin-wide cultural development would provide answers to questions about Chacoan cultural growth. Using known outlier data (14 outlying sites are shown on his Figure 1 map) Altschul proposed that several centers with Chacoan culture traits may have developed in the San Juan Basin fairly independently as the "result of a standardized cultural response to stress, rather than diffusion from one or two major cultural centers" (Altschul 1978:109). He believed that the evidence for development of satellite communities was weak, and while he acknowledged the presence of Chacoan roads, he appears to have believed them to be limited to the Chaco Canyon center of activity. Outlier and road research being conducted at the time Altschul's article was published and had already produced a minimum of forty outliers and evidence for the linkage of many of these sites to Chaco Canyon. More recent research has shown that a northern regional center may have developed late in Chacoan cultural evolution but that it was tied to the Canyon at least early in its growth. The point is not that Altschul's explanatory model was incorrect but that models could be altered appreciably as a result of the rapid accumulation of road and outlier data between 1970 and 1978.

The collecting of road and outlier information coincided with a number of other archaeological projects carried out in the San Juan Basin, all of which contributed to a better understanding of past settlement and subsistence in the area. Environmental research, in particular, provided a much sounder basis for predicting past response to climatological change. In this process the opportunities for interpreting the function of Chacoan roads increased considerably.

As has been pointed out previously, functional interpretation of Chacoan roadways has been almost exclusively economically oriented. Although explanations for the roads and road network have become more sophisticated and are no longer dependent on the direct application of geographers' transport and marketing models, road use as means for moving goods or moving people to produce and transport goods has been almost unquestioningly accepted. Several factors have bolstered taking an economic approach to explaining Chacoan roads. The apparent increase in population in Chaco Canyon coupled with deteriorating soils, unpredictable moisture patterns and depletion of local resources were strong arguments for the establishment of production centers outside the Canyon and the cycling of goods at least to the Canyon if not for redistribution throughout the San Juan Basin. As more outliers were discovered in zones with more productive soils, more dependable rainfall, and in some cases highly localized resources, the redistribution-marketing theory gained greater credence.

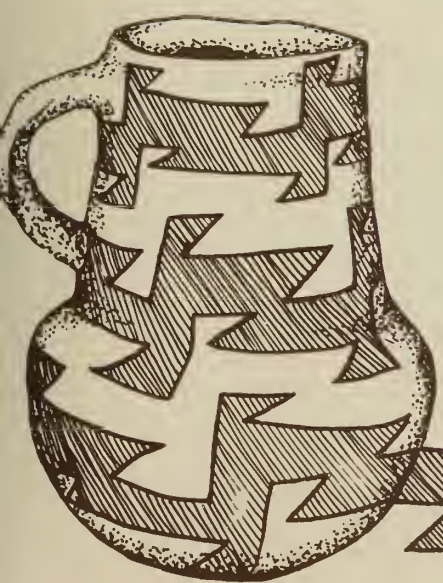
But there is a need for caution in unreservedly accepting an economic explanation for Chacoan roads. Data supporting population estimates, soil productivity and moisture patterns frequently have been tenuous and should be used with care when developing explanatory models. In addition, some

feature of Chacoan roads are difficult to explain within an economic context. For example, the volume of transport would never have reached proportions requiring the construction of two, possibly four, parallel nine-meter wide roadways over considerable distances, yet double roads have been reported to the north and south of Chaco Canyon. Similarly, it is unclear what economic advantages would have been gained by routing five separate roads south from Pueblo Alto to points in the Canyon bottom (a distance of less than a kilometer) all of which are within 1.2 km of one another (not to mention the need to construct three major and at least two minor ramps as well as rock-cut stairways on these routes). Nor has Chacoan road width been shown to have any economic benefits--if it did, one would then need to explain why some roads are half the width of others. Finally, there are few good empirical data on kind and quantity of goods being traded and redistributed within the Chaco, though recent studies such as those by Toll, Windes and McKenna (1980) and Toll (1981) are a positive step toward resolving this problem.

In conclusion, research on Chacoan roads and especially that research carried out in the past ten to twelve years has added enormously to the Chacoan data base and has contributed significantly toward altering concepts of the evolution of Chacoan culture. The results of this work also have value for planning future research. To summarize points made previously, it is clear that use of aerial imagery and aerial reconnaissance should be critical aspects of any planned Chacoan road study. The proper design of both photography and reconnaissance will be even more crucial, however, than the simple use of these techniques. Testing of methodological procedures recommeded by Ware and Gumerman has never been fully explored and would serve as an important point of departure. Road verification techniques, especially subsurface testing, should continue to be implemented and refined.

A major deficiency in Chacoan road research has been the lack of a standardized system for defining and describing the road network and all network components. This may already have hampered some interpretive studies and will certainly pose problems for comparative analysis in the future if not corrected. Finally, although there is much to support an economic explanation for Chacoan road development, there are unresolved problems with this approach. More thought should be given to constructing multi-functional models for explaining the evolution and function of the Chacoan road network.

In the final analysis, all roads research should be geared toward conserving the maximum data possible on this remarkable feature of Chacoan culture growth. Vestiges of this land route system have been disappearing at an accelerating rate during the past century, as attested by early descriptive accounts of roads that are no longer visible and analysis of over fifty years of aerial photography. Judicious use of available and new methodologies and thoughtful creation of explanatory models will go far in preserving a record of Chacoan roads.



CHAPTER 4

CHAPTER 4

EVALUATION OF AERIAL PHOTOGRAPHY

Aerial photography is a valuable tool in the search for prehistoric Chacoan roads. Although historic records indicate that many of these roads were known long before aerial photographs came into use, modern techniques of initial road identification depend almost solely upon information gained from the aerial perspective.

In recent years, extensive photo interpretation of areas within the San Juan Basin has greatly expanded the boundaries of the known or suspected road network. Many sets of imagery were examined and their utility was found to be highly variable depending on a number of factors. If additional imagery is obtained in the future under conditions optimal for road identification, the potential for discovery of new road segments and systems is considered high.

Methods

Nomenclature

Several hundred miles of possible Chacoan road systems have been identified outside of Chaco Culture National Historical Park, most of them linking major sites known as outliers or great houses. A road "system" is defined here as any road which links more than two outliers; the major road systems identified to date include the North Road, South Road, Coyote Canyon Road, Mexican Springs Road, Southeast Road, and Chacra Face Road (see Figure 4-1, back pocket). A review of current literature reveals contradictions in the names of some road systems; the approach followed by this project has been to adopt the earliest name in the literature, with one exception. Vivian's West Road (Vivian 1972) was renamed the Penasco Blanco to Ahshislepah Road on the grounds that it does not appear to form a road system. In general, road systems are named either by their geographic destination or by the direction of the route of the road from Chaco Canyon. For example, the Coyote Canyon Road links Grey Ridge (near Coyote Canyon), Peach Springs and Standing Rock with Chaco Canyon; the South Road links Kin Ya'a, Bee Burrow and Upper Kin Klizhin with Chaco Canyon.

Many additional possible roads have also been mapped which link outliers with each other or with other areas and which may or may not be part of known road systems. Such roads have been named for their end points, resulting in such names as the "Standing Rock to Peach Springs Road" which is part of the Coyote Canyon Road system, and the "Andrews Ranch to Casamero Road" which is not part of any known road system. Several roads radiating from outliers have no known destination or end point; these are named for the direction of travel from the outlier, such as the "Coolidge Northwest Road".

Photointerpretation

Photointerpretation for this project occurred in two phases. The first phase involved re-examination and re-mapping of several road systems (see Obenauf 1980a), as well as examination of selected additional areas. The results of these efforts were used in the reconnaissance and intensive inventory surveys for this project. The second phase consisted of photointerpretation of imagery for most known Chacoan outliers and, in a few cases, the distance between the outlier in question and the closest neighboring outliers.

Five different sets of imagery were used--Soil Conservation Service black-and-white, BLM in-house photography in both black-and-white and color, and low sun angle photography at two different scales. The Albuquerque District of the BLM holds almost complete coverage of the San Juan Basin in the first three of these sets of imagery.

The first step in the photointerpretation process was to identify the area of interest using either the mapped location of a previously known road, or a defined area to be examined for the presence of a road. Aerial photographs were then examined stereoscopically for lineations. Observed lineations were marked directly on the photograph with a photo marking pencil (grease pencil) by placing one dot at each end with a line alongside it (Figure 4-6). The alignment was then followed to see if additional segments could be found. If so, these were also marked and followed.

There are many short linear features visible in the aerial photography of the San Juan Basin, most of which are probably not prehistoric roads. Attempting to discover "alignments" connecting these features without beginning with a general bearing would have been a monumental task. By beginning photointerpretation near outliers and following lineations outward, the problem was reduced to a manageable size; this strategy was especially effective since roads tend to be most distinct in the vicinity of outliers. The tactic of examining areas between outliers was most successful when a "highly probably" road segment was visible at one of the endpoints, but in a few cases "highly probable" segments were located between outliers when none were visible near the outliers themselves. In these situations a field reconnaissance has proved useful, since road segments not visible on the imagery are sometimes visible on the ground. Additionally, it may be possible to identify the route of a road through identification of road-related types of sites. Starting with the "highly probable" segment, therefore, the field investigators may be able to extend the route of the road. A check of some of the

"possible" segments may confirm that they seem to be prehistoric roads.

A few outliers have been examined for prehistoric roads on three or four sets of imagery; more on two, and most on at least one. The possibility remains high that many more miles of roadway will be discovered in the future. Since so many factors can be responsible for road visibility, ideally all available imagery of an outlier and the areas between it and the surrounding outliers should be examined in the search for prehistoric roads.

Equipment

Photointerpretation for this project was performed using a Topcon mirror stereoscope mounted on a scanning track. Lenses were available to provide 3-power magnification. Three-power magnification of imagery at scales of around 1:30,000 proved to be most productive, as had been the case in the past (Obenauf 1980a:55).

Possible roads marked on the photographs were transferred to USGS topographic maps using a Bausch and Lomb Stereo Zoom Transferscope in the monocular mode. Scale adjustment, especially in areas with few landmarks, was often difficult. Accuracy of the transfer using the Transferscope was approximately equal to the accuracy gained using a Mapograph.

Documentation

A "Photointerpretation Form" was utilized to record the results of the photointerpretation; one form was filled out for each visible segment (see Figure 4-2). Information recorded on the form included road name, segment number, legal description, topographic quadrangle name and photo numbers. Notes on road visibility for each set of imagery examined, as well as subjective impressions about factors affecting visibility, were provided in narrative form. The information on these forms was helpful in tracking overall trends of road visibility between different sets of photography.

Assessing the Roads Data Base

In assessing what might be called the aerial photographic data base for prehistoric roads it is necessary to know the likelihood that all of the system alignments which appear on the photographs are in fact prehistoric roads. There are at least two different ways of viewing the "mileage" of prehistoric roads which has been used to date. Using one approach, the mileage of a road connecting end points A and B is calculated by simply measuring the ground distance between them. However, if one distinguishes between the number of miles which are appearing as imaged segments, and the number of miles which show no evidence of the alignment, a different picture emerges. The number of miles which are actually visible as an imaged alignment in the photography is in most cases quite small when compared with the total mileage between endpoints. In only rare cases have prehistoric roads been identified which have continuous swales on the aerial photography; most have been recognized only as discontinuous segments.

Probable vs. Possible Segments

Imaged swales may be separated into two categories. The first category includes lineations which have a high probability of being prehistoric roads. Such segments include portions of known road systems such as the North Road or the South Road, segments in close association with outliers which fit the recognition pattern for Chacoan roads, and segments which have already been verified on the ground. The second category includes less-distinct lineations which have been mapped primarily because of their location between outliers. Field checks will probably verify virtually all of the segments in the first group ("highly probable roads"), but only some of the segments in the second group ("possible roads").

Field Assessment

Most field assessments of prehistoric roads have been casual reconnaissance surveys, many of which were no more than "spot checks"; few records were kept and they were done mainly for the purpose of identifying the road and major features in the cultural landscape. The main difference between the documented reconnaissance survey and the second type of survey, the intensive survey, is that in the latter, systematic control is maintained over the area which is examined and the level of documentation which is maintained (see further discussion in Chapter 7). In general, the reliability, comparability and utility of information collected using an intensive approach far exceeds that collected under a reconnaissance or spot check strategy, depending on the visibility of the road alignment itself.

The Verification Issue

A major management objective of this project was to develop a procedure for "verifying" the existence of prehistoric roads which appear as linear features on aerial photographs. The word "verification" can be interpreted in two ways. The first interpretation refers to finding on the ground what is appearing as a lineation on the photo. If successful, one has "verified" the photointerpretation by finding what was photographed. The second approach, however, requires also that the feature fit the criteria for a prehistoric road. For the purpose of this project, we are defining road "verification" as the clear identification of a feature on the ground which can <u>additionally</u> be demonstrated to fit the

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CHACO ROADS PROJECT
PHOTOINTERPRETATION RECORD

Road Name _____ Segment No. _____

Map Reference _____

Historic Map Reference (if any):

LOCATION: Township _____ Range _____ Section _____

IMAGERY USED:
1) Agency _____ Flight _____ Scale _____ Date _____ Photo Nos. _____
DESCRIPTION:

2) Agency _____ Flight _____ Scale _____ Date _____ Photo Nos. _____
DESCRIPTION:

3) Agency _____ Flight _____ Scale _____ Date _____ Photo Nos. _____
DESCRIPTION:

COMMENTS:

Recorded By: _____

Date: _____

Figure 4-2

criteria for prehistoric roads.

It is important to maintain the distinction between the verification of a road segment and the verification of an entire road system. The verification of an individual road segment in an isolated area along an imaged road system does not necessarily mean that the entire road system is verified. Conversely, the failure to locate on the ground evidence which would indicate a prehistoric road segment in a specific location does not in fact mean that the entire road system does not exist.

Current Status of Photointerpretation for Chacoan Roads

Roads Investigated by the Field Crew

Six different roads were field investigated during this project, at varying levels of intensity. These roads were considered to represent the known range of variation of Chacoan roads, and were near energy development areas. All of these previously known roads were re-photointerpreted and re-mapped prior to field investigation (see Figure 4-1).

The North Road system connects Pueblo Alto in Chaco Canyon with Pierre's Ruin, Halfway House, Twin Angels, and presumably Salmon Ruins on the San Juan River. Several sets of imagery were examined to determine the route of the North Road: SCS photography taken in the mid-1930s, BLM in-house photography in both black-and-white and color taken in 1973, and black-and-white low sun angle photography taken especially for this project in 1981. Maps prepared from the interpretation of USGS and SCS imagery (Obenauf 1980a) were also utilized. The location of the road could be seen or projected for much of the route of the road on the earlier sets of photography, but the low sun angle photography proved to be much more useful for defining the road location. Previously imaged segments were often more visible, and many new parallel segments were mapped.

The South Road (Figures 4-3 and 4-4) connects Kin Ya'a (Figure 4-5), Bee Burrow, and Upper Kin Klizhin with South Gap. The north end of this road is first visible in the vicinity of Upper Kin Klizhin, and it is highly visible for much of the distance southwards to Kin Ya'a. A fork of this road leading to Marcia's Rincon in Fajada Gap (first named the Latrine Road and later the Rincon Road) was field checked by the Remote Sensing Project in 1973. It could not be followed outside of the Fajada area on the photos or on the ground, but was located later from a light aircraft. A portion of this road near Upper Kin Klizhin was field checked for the current project, but the results were inconclusive; further discussion can be found in Chapter 8 and Appendix A. The South Road was examined on SCS and BLM photography for this project. Few changes from the previous photointerpretation of USGS and SCS imagery (Obenauf 1980a, 1980b) were noted.

Four other roads were examined for the field portion of this project--the Penasco Blanco to Ahshislepah Road, Pueblo Pintado to Chaco Canyon Road, Casa del Rio to Lake Valley Road, and South Gap road complex. The Penasco Blanco to Ahshislepah Road (Vivian's West Road) is first visible on aerial photographs across the Escavada Wash from Penasco Blanco in Chaco Culture National Historical Park. It is exceptionally visible on both the SCS and BLM imagery (Figures 4-6 and 4-7) for three miles as far as Ahshislepah Canyon, but no road has been seen emerging on the other side of the Canyon. (Editor's Note: See Chapter 11). The Pueblo Pintado to Chaco Canyon Road is readily visible for much of the distance between Pueblo Pintado and the head of Chaco Canyon. At this point, it presumably descends into the Canyon and is no longer visible on the photographs. (This road was examined on both the SCS and BLM imagery and was found to be more continuously visible on the SCS imagery.) The complex of roads heading west from South Gap towards Kin Klizhin and Kin Bineola was also investigated by the field crew. Segments of these roads are highly visible on the photography in the South Gap vicinity, but generally are less clear closer to Kin Klizhin and Kin Bineola. The Casa del Rio to Lake Valley Road is first visible a few hundred feet west of Casa del Rio and is quite distinct for about a mile. At this point visibility diminishes and the road is seen as a series of discontinuous segments. Two branches or forks are evident near Casa del Rio, and it is possible that this road was once part of a system linking the Skunk Springs/Newcomb area with Chaco Canyon.

Roads Not Investigated by The Field Crew

A number of additional road systems had been mapped previous to this project using USGS imagery flown during the 1950s and 1960s (Obenauf 1980a). While some of these roads have been field checked by other researchers, others remain totally unverified. These road systems are discussed below.

Coyote Canyon Road. The Coyote Canyon Road is clearly visible for long distances from near Grey Ridge to Peach Springs and past Standing Rock. Although this road is last visible about 10 miles northeast of Standing Rock, it presumably continues on to Chaco Canyon through South Gap. Michael Marshall performed a reconnaissance survey of the Standing Rock to Chaco Canyon portion of this road, reporting that it was easily followed for about 12.5 km (Marshall et al. 1979). The Grey Ridge to Peach Springs and Peach Springs to Standing Rock portions of the Coyote Canyon Road, while not yet field checked, are probably prehistoric. They are almost continuously visible on the USGS imagery, and their appearance is identical to the Standing Rock to Chaco Canyon portion. The Coyote Canyon Road was briefly scanned on

Figure 4-3. SCS aerial photograph taken in 1930s, showing portion of the South Road between Upper Kin Klizhin and Bee Burrow, south of La Mesita de la Junta. Compare to Figure 4-4.

Figure 4-4. BLM ARS aerial photo taken in 1973, showing same area visible in Figure 4-3.

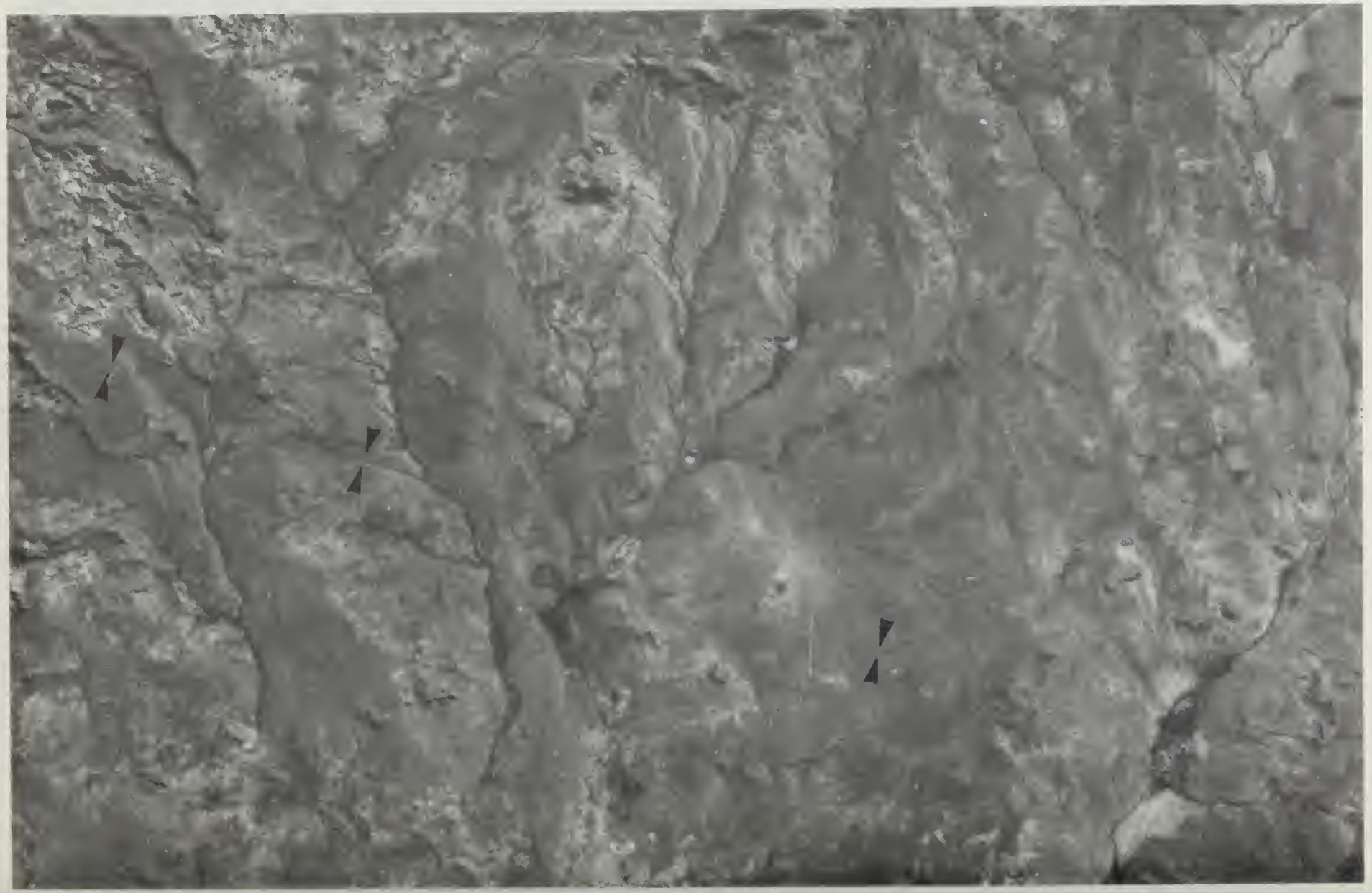


Figure 4-5. Low sun angle photograph of the South Road in the vicinity of Kin Ya'a Ruin. A-main alignment of the South Road; B-spur road to Kin Ya'a; C-historic reuse of prehistoric road; D-Kin Ya'a boundary fence; E-great kiva.

Figure 4-7. 1973 BLM ARS aerial photograph of the Penasco Blanco to Ahshislepah Road. Note low visibility of the road segments in this photo, in contrast to the high visibility of the same segments in Figure 4-6.

Figure 4-6. 1930s aerial photograph of the Penasco Blanco to Ahshislepah Road, showing grease pencil markings made by photointerpreter. A-Penasco Blanco Ruin; B-a portion of the Penasco Blanco to Ahshislepah Road; C-Chaco Wash; D-stairway complex; E-Los Aguages; F-isolated segments of a second prehistoric road. Note high visibility of prehistoric road segments in this photograph, in contrast to the low visibility of the same segments in Figure 4-7.

the SCS imagery (Figure 4-8) during the photointerpretation for this project, and while clearly visible in many places, it was not as continuously visible nor as distinct as on USGS imagery flown thirty years later.

Mexican Springs Road. This possible road system was first located during the photointerpretation reported in Obenauf (1980a). It has not been field checked and is not positively associated with any known outliers. While some individual segments composing this road appear to fit the photorecognition pattern for Chacoan roads, it is not as continuously visible as the Coyote Canyon Road or the South Road. These factors make it imperative that this possible road be field checked to verify its existence.

The possible Mexican Springs Road extends from the Mexican Springs area to within a few miles of Kin Bineola. If the road is projected along this same bearing, it aligns with Kin Klizhin and the South Gap entrance to Chaco Canyon. It lies near locations predicted for outliers in the Mexican Springs area by Loose (1978); and is also present between the Grey Ridge and Tohatchi outliers, although it cannot be seen entering either site. Possible spurs projecting from this road may connect with the Standing Rock and Indian Creek outliers.

Southeast Road. The possible Southeast Road system heads south from Fajada Gap in Chaco Canyon to the Greenlee Site. Ten miles south of Greenlee it bifurcates, the west

Figure 4-8. 1930s photograph of Peach Springs to Standing Rock portion of Coyote Canyon Road.

Figure 4-9. SCS aerial photo taken in the 1930s, showing prehistoric road segments converging at Kin Nizhoni (A). Compare to oblique photo in Figure 4-10. Lower Kin Nizhoni is shown at (B).

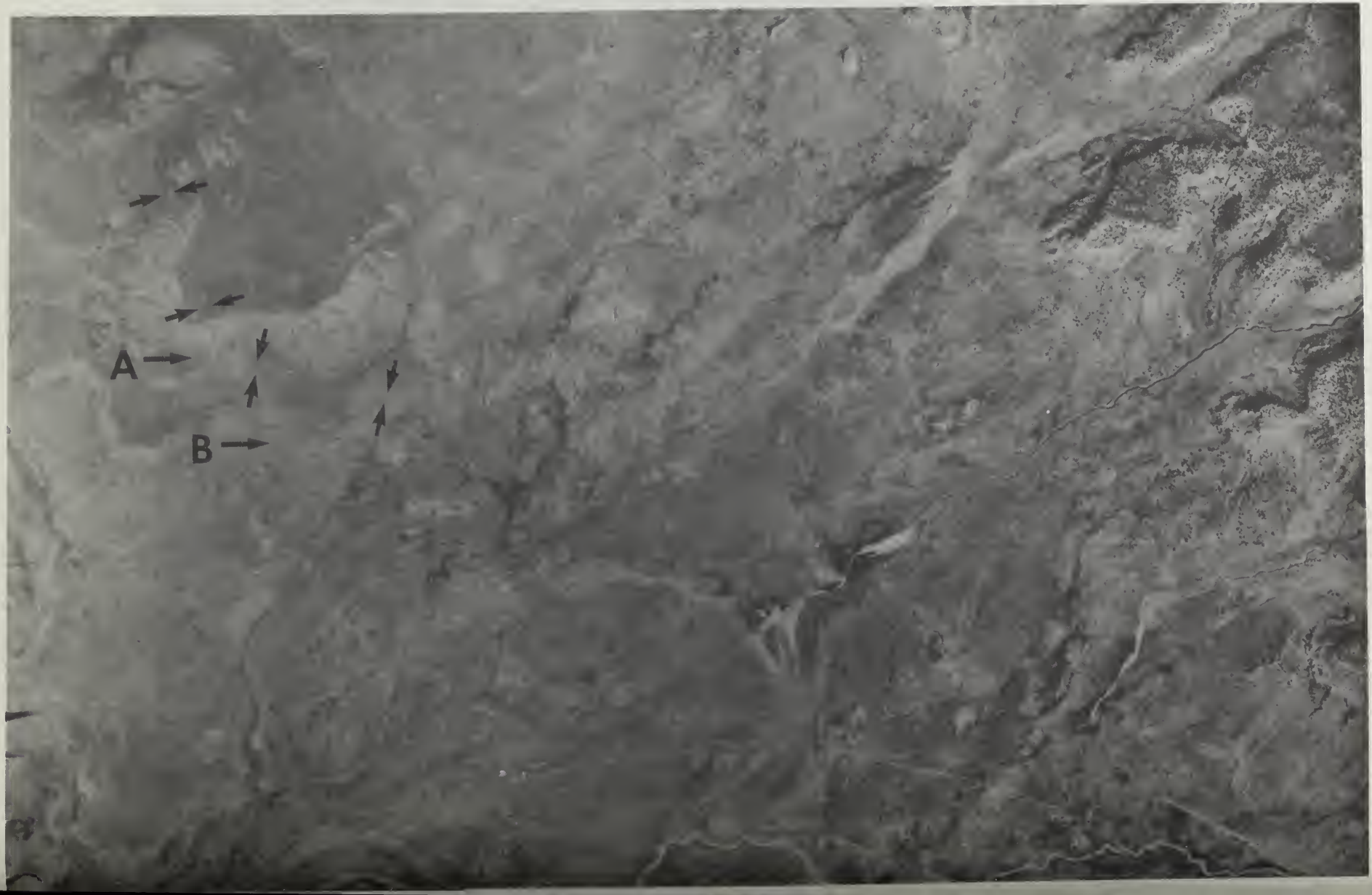


Figure 4-10. Oblique low altitude photo showing prehistoric road segments converging at Kin Nizhoni (A). Compare to Figure 4-9.

fork going to Kin Ya'a, 20 miles from Greenlee, and the east fork going to San Mateo, 45 miles from Greenlee. This possible road system has never been more than spot checked--only a few segments near outliers have been briefly examined in the field. The West Fork leading into Kin Ya'a was walked for a short distance in 1973 by the Remote Sensing Project field crew. In addition Robert Powers and Wolcott Toll of the Chaco Center spot checked one portion adjacent to the Greenlee Site and another at a point about 5 miles south of the site in 1978. Powers reported that while it looked like there might be a road in both areas he was not confident enough to feel that the road should be considered verified (R. Powers 1982: personal communication). Other segments of road associated with the San Mateo-El Rito-Kin Nizhoni complex (Figure 4-9 and 4-10) were located during the field work reported in Marshall et al. (1979), and many of these segments should be considered as "highly probable" roads. Unfortunately, none of the long stretches of possible road between Kin Ya'a and Greenlee, and San Mateo and Greenlee have been field checked. (Editor's Note: See Chapter 11).

Chacra Face Road. A road paralleling the southern edge of Chacra Mesa starting near Fajada Gap and extending southeast was mapped independently by both Gwinn Vivian and the Remote Sensing Project, and was partially field checked by C.R. Morrison and Gwinn Vivian in 1974 (Figure 4-11). This road was extended several miles by the photointerpretation for this project, but no destination could be determined. It may lead to the same area as the possible Pueblo Pintado South Road, and could extend as far as the Guadalupe Ruin outlier (Figure 4-12).

Chaco Canyon Roads. The Remote Sensing Project mapped and field checked many miles of possible roadways in the vicinity of Chaco Canyon. Many of these were short segments with no known destinations. Only major roads within the Park with known end points are mapped in Figure 4-1.

Several road systems appear to originate at Chaco Canyon, including the North Road, South Road, Southeast Road, and the Mexican Springs Road. Other roads originating at Chaco that are not part of known road systems include the Penasco Blanco to Ahshislepah Road, South Gap roads, Chacra Face Road, and Pueblo Pintado to Chaco Canyon Road. In addition, many other shorter roads restricted to the area within and around Chaco Canyon have been identified and field checked. Among the most important of these are the Pueblo Alto to Pueblo Bonito Road, Pueblo Alto to Chetro Ketl Road, Tsin Kletzin to Casa Rinconada Road, Chetro Ketl to Poco Site Road, and Penasco Blanco East and West Roads.

The Chaco North area is the apparent destination of a series of roads, many of which radiate from Pueblo Alto, which have been extensively examined from both the aerial and ground perspectives (Ware and Gumerman 1977). In addition to those roads examined by Ware and Gumerman a myriad of other photolineations, many of them

Figure 4-11. Oblique aerial photograph of photo-visible segment of Chacra Face Road, indicated by arrows. Chacra Mesa is shown in background.

Figure 4-12. Oblique aerial photograph looking westward showing (A) prehistoric road leading to (B) Guadalupe Ruin.

KIN INDIAN RUINS

GREASY HILL PUEBLO

ESCAVADA COMPLEX

PAINTED CLIFFS MESA

POCO SITE

PUEBLO ALTO RUINS

Kimbeto Wash

Betonnie Tsosie Wash

Escavada Wash

Wash

Canyon

Canyon

Yazzi Well

Chaco Canyon Trading Post

Landing Strips

Willeto Well

Pueblo Bonito Ruins

Pueblo Bonito Ranger Station

Chetro Ketl Ruins

Indian Ruins

Well

BM 6214

BM 6125

BM 6281

BR 6140

6548 Pueblo Bonito

FIGURE 4-13

CHACO NORTH PHOTO INTERPRETATION RESULTS

——— INTERPRETED AS PREHISTORIC FEATURE

- - - - - - INTERPRETED AS PROBABLE PREHISTORIC FEATURE

NORTH

0 1/2 1 MILE

SCALE

presumably roads and identified by the NPS Remote Sensing Project, were "verified" as being prehistoric in origin (Morain, Budge and Komarek 1981:33). While photointerpretation of low sun angle photographs taken specifically for this project extended the imaged length of ground-verified roads examined by Ware and Gumerman in several instances, it strongly suggested that many of the previously mapped "roads" do not fit the photorecognition criteria of other ground-verified prehistoric roads in the area. The results of low sun angle photointerpretation of the Chaco North area are presented in Figure 4-13.

Roads Associated with Outliers. SCS 1930s imagery of almost all of the known outliers, including the 33 Archaeological Protection Sites identified in PL 96-550, was examined for possible prehistoric roads. Much of the BLM 1973, USGS 1950-60, or NPS outlier imagery was also examined. Some of the roads associated with outliers are part of known road systems, some link only two outliers, and some have no known destination. The results of this photointerpretation are on file at the BLM, Albuquerque District Office.

Evaluation of Existing Imagery

A great deal of imagery is available for the various roads and outliers. Many different government agencies have acquired imagery of all or part of the San Juan Basin at different scales, emulsions, and dates. These agencies include the Soil Conservation Service, the Fish and Wildlife Service, the Geological Survey, the Defense Mapping Agency, the National Park Service, the Bureau of Land Management, the Bureau of Indian Affairs, and the Forest Service, as well as agencies of the New Mexico State government such as the Highway Department. Imagery has also been flown by numerous private companies, including Phillips Petroleum, Mobil Oil, and Thomas R. Mann and Associates.

In evaluating existing imagery, there are a number of factors to take into consideration which affect the utility of this imagery for roads research. These are discussed in detail in Chapter 5, and will only be briefly mentioned here. First, some of the imagery has been "dodged," a process whereby print contrast is reduced. This has been done on the 1973 BLM in-house black-and-white photography, for example, and it seriously reduces its utility for this type of work. Another factor to consider is that many of the photographs are taken at such a small scale that it is impossible to locate oneself and the linear feature on the ground with any precision. Virtually any scale over approximately 1:12,000 will cause this problem. A third factor is time of year. Almost every set of existing imagery was taken during the late summer or fall, at a time when vegetation is dormant. However, fieldwork has shown that one of the main factors causing contrast in the photographed image of the prehistoric alignment is vegetation. No widely accessible imagery has been taken in the early spring during the growing season, at a time when vegetation differential would be maximized. A final factor is sun angle. With the exception of photography flown in the fall of 1981 for this project, all available imagery is of "engineering quality," flown between 10:00 AM and 2:00 PM when the sun was directly overhead. (Editor's Note: Additional low sun angle photography was flown during Phase II of this project, as described in Chapter 11.) Shallow topographic relief characteristic of the roads, however, is most visible when the sun is low, casting long shadows.

In general, the SCS imagery is the most productive of existing imagery. It was flown between 1934 and 1936 at scales between 1:20,000 and 1:30,000, before automobile and truck travel was common in the area, and before much of the development which currently obscures prehistoric roads had occurred. For this reason, it is extremely useful even though image quality is generally poor. Another factor which may have enhanced the visibility of the roads in this imagery is the widespread overgrazing and erosion which characterized the landscape at that time.

The BLM ARS photography was flown in the fall of 1973 with color negative film at a scale of 1:31,680. Prints of virtually all of the San Juan Basin are currently available in both black-and-white and color. In general the color prints proved to be more useful, although in the past the opposite has been true for other sets of imagery. The black-and-white prints used for this project were over-dodged, seriously reducing their utility for roads research. Flown between 9/29/73 and 11/29/73, most of the vegetation which could have enhanced road visibility was already dead by the time the photos were taken. Modern energy development, increased automobile and truck travel, and residential expansion have all obscured prehistoric roads in the Basin. However for these same reasons, this photography was more useful in the field than the earlier SCS imagery.

The last set of imagery examined was the low sun angle photography of the North Road flown especially for this project. This imagery was taken in October 1981 at scales of 1:24,000 and 1:12,000 on black-and-white negative film. The North Road had previousl been examined on over half a dozen different sets of imagery, but on no other set was the road as consistently visible as on the low sun angle imagery. In general, the shadows produced by the early morning sun greatly enhanced visibility of the road. Not only was the known route of the road clearly visible, but several previously unknown parallel segments were also visible (see Chapter 6). As is often the case in photointerpretation, this project-specific imagery proved to be the most productive.

Although this imagery was taken after the intensive inventory of the North Road corridor was completed, subsequent field examination confirmed its usefulness on the ground. Since it portrays the modern landscape at a reasonably large scale, the location of sites and the enhanced alignment on the ground is relatively easy. For this purpose, the 1:12,000 set was more helpful, although the prehistoric roads were more visible on the 1:24,000 imagery.

Although not utilized for this project many of the outliers and road systems have been examined on USGS mapping photography (Obenauf 1980a, 1980b). The results of this previous research are summarized here. This imagery, dating from 1950 to the mid-1960s, was flown at various scales around 1:30,000 and was used to produce the USGS topographic maps. Photointerpretation of the USGS mapping photography has been extremely productive in the search for prehistoric roads; this was the basic imagery source for the National Park Service Chaco Center roads research and for the thesis research reported in Obenauf (1980a). In general, this imagery was flown from spring to late fall; the majority was flown between the hours of 10:00 AM and 2:00 PM. Modern disturbances have obscured more prehistoric roads on this imagery than on the 1930s SCS imagery, but markedly fewer than on the 1973 BLM in-house photography.

Large-scale recent photographs of the former Chaco Canyon National Monument as well as of about 50 of the outliers, flown in the middle to late 1970s at scales of 1:3000 to 1:6000, were also previously examined for roads (Obenauf 1980a). The outlier photography was in the form of stereo pairs covering the outliers and the area surrounding them. Some probable roads, especially at Pueblo Alto, were visible; however, there were generally two problems with this imagery. First, the scale was too large, causing the roads to dissolve into the landscape. Also, most of the segments visible on this photography were very short and few of them could be followed out of the immediate vicinity of the sites.

Recommendations for New Imagery

Most sets of currently available imagery are less than ideal for the recognition of prehistoric roads, and have serious drawbacks which limit their utility to the roads researcher. Given its relatively low cost, the potential for gaining new information and the potential saving in field time which it offers, obtaining new aerial photography may be highly desirable prior to beginning a field project. As has been suggested, a number of factors should be controlled to obtain maximum road visibility on new photos. For the sake of clarity, these factors are summarized here:

1. Sun Angle - Low sun angle photography will provide the best resolution of prehistoric roads; the time available to the photographer (between the rising of the sun and the point at which shadows are no longer lengthened) is generally not much more than one hour. If possible, photos should be taken at the time of year when the rays of the rising sun are most nearly perpendicular to the prevailing axis of the road. The best time of day is early morning, when there is a minimum of haze and dust in the air.

2. Season - Photos should be taken during the spring growing season, as a general rule about two weeks after the first heavy rain subsequent to the onset of warmer weather.

3. Scale - Optimum scale will vary according to how well the road location is known (the road is easier to miss at a larger scale), and what the imagery is to be used for. To provide maximum utility to the field archaeologist, no smaller scale than 1:12,000 should be used. Often two scales (1:12,000 and 1:24,000) can be flown at little additional cost; if available, this represents the most desirable option.

4. Processing - Low sun angle photography is very difficult to process, and special procedures are necessary. Photography for this project was flown by Thomas R. Mann and Associates, of Albuquerque; this firm was able to successfully process the photos, using techniques which they developed specifically for this project. Prior consultation with the aerial photographer is necessary to be sure that the difficulties involved in film processing are understood.

5. Film - The film used for the flights should be "fast" film, specially suited for conditions of low light.

6. Ground Controls - If panelling is to be used for the purpose of maintaining ground control, it should be placed in an area which is not apt to be obscured by shadow. Panels should be at least double or triple their normal size to assure their visibility in the deeply shadowed photograph.

7. Reconnaissance - Unless the road location is extremely obvious and well established, it is advisable to perform at least a spot check or aerial reconnaissance prior to obtaining photography. Panelling placed periodically along the route, as well as at changes in angle or direction, can greatly assist the pilot. Because of the short duration of the low sun angle period, the time available for the pilot to become "oriented" to the project area will be minimal.

The Potential for Discovering New Outliers and Roads

The potential for discovering additional roads is high for many reasons. "New" outliers are still being discovered, and each one holds the promise of associated roads. Not all of the known outliers have been examined for roads, and not all of the areas between adjacent outliers have been examined. In addition, new low sun angle photography

flown specifically for photointerpretation of potential roads promises greater accuracy in the definition of previously known roads, and new opportunities for discovering currently unknown roads.

An evaluation of the physical environment may, in some cases, facilitate exploration for previously unknown roads. Chapter 5 contains a prediction model relating the effects of some aspects of the environment on road visibility. Although the model is highly generalized and may be invalidated by localized natural and cultural factors, it still serves as a preliminary exploration guide. For example, the knowledge that prehistoric roads are seldom photovisible on alluvium, shale, sandstone, colluvial footslopes and cliffs, allows one to eliminate major portions of the landscape from the initial photo-exploration stage. By concentrating on the remaining areas where the effects of the environment on road visibility are likely to be minimal or enhanced, exploration is made more efficient, with less photointerpreter fatigue and error. This methodology is intended only as an initial guide to the exploration process. Once road segments are identified, even the unlikely areas between imaged segments should, of course, be examined. A more detailed discussion of the effect of environmental factors on photovisibility is presented in Chapter 5.

There are major portions of the San Juan Basin (e.g., the area to the southeast of Chaco Canyon in the Basin floor) which, on the basis of the predictive model, are unlikely to contain extensive areas of well-preserved or visible road segments. These areas, however, cannot be categorically dismissed from future exploration for prehistoric roads. It must be emphasized that cultural factors, especially the degree of construction on the prehistoric road, often override natural factors in photovisibility, and that cultural determinants of construction efforts are incompletely understood at best. Future exploration should be guided by the likelihood of a road having once existed in an area, rather than by the presumed likelihood of its preservation or visibility.

Chapter Summary

Most of the initial identification of prehistoric road alignments has been achieved by aerial photointerpretation. It is important that future research be done in a manner which will ensure results compatible with previous efforts and that documentation standards are observed. The current project focused on portions of only a few of the known or presumed prehistoric road systems; several other systems have been identified throughout the Basin, none of which have been thoroughly inventoried or documented. Many of the suggested systems remain "unverified" as prehistoric features. Although there is a great deal of existing aerial photography available for different areas of the San Juan Basin, much of it is not usable for roads research due to problems with scale, developing, exposure, etc. The photographed image of the prehistoric road is in most cases indistinct, and its visibility varies greatly between sets of aerial photography. In some cases it may be advisable to fly new photography to serve as a basis for inventory efforts, using techniques to maximize road visibility.

The potential for discovering new roads in the San Juan Basin appears to be high. A greater understanding of the factors affecting visibility will no doubt lead to greater success in future photointerpretation and ground verification studies. The number of "high probability" lineations without identified end points suggests that we do not yet understand the full extent of the Chacoan road network.

CHAPTER 5

CHAPTER 5

FACTORS AFFECTING THE VISIBILITY OF ROADS

One factor which complicates roads research is the wide range of variability in the appearance and visibility of the prehistoric alignment. In this chapter, factors which may affect visibility from both the aerial and ground perspective are discussed.

The Road Image - What Causes it?

Prior to the late 1960s most research on prehistoric roads in the Colorado Plateau was done largely as an afterthought to other archaeological objectives. Little concentrated effort was expended in investigating geological factors affecting visibility of either prehistoric or historic roads (such as sedimentation and erosion within former roadways, and geomorphologic context), or in developing a standardized methodology for describing these types of information. Within the last decade, however, several detailed studies of the roads have been conducted (e.g., Vivian and Buettner 1971, Gumerman and Ware 1972, and Loose and Kemrer 1982). The Remote Sensing Division and the Chaco Center of the National Park Service (NPS) began a long-term study of remote sensing methodology and ground observation of many road segments within Chaco Canyon National Monument in the early 1970s. In addition, Obenauf (1980a) mapped major portions of the Chacoan road network and examined many of the variables affecting road visibility on aerial photographs as a part of a graduate study at the University of New Mexico. The most extensive examination of visibility factors as of the present time was conducted by Gumerman and Ware (1972, Ware and Gumerman 1977), who investigated many variables and placed trenches across several road segments near Pueblo Alto.

A discussion of visibility of prehistoric roads must of necessity differentiate between photo visibility and ground visibility. As a general rule, lineations associated with prehistoric features are more visible and easily located on aerial photographs or other remote sensing imagery than on the ground. Frequently, lineations which are easily discernable on the imagery are barely visible on the ground, and it is difficult to determine precisely what characteristics of the prehistoric alignment are causing the photographed image. This is discussed in the following paragraphs.

Topographic Relief

Topographic relief is probably the single most significant factor producing the photographed image of a prehistoric road. Observable relief varies markedly between road segments and is affected by a number of historic and prehistoric environmental and cultural factors.

Topographic relief may be of either primary or secondary origin. Primary relief is here defined as that relief resulting from construction, maintenance, or natural erosion during usage of the road. For all practical purposes, this may be considered to be the relief of the road at the time of abandonment. Secondary relief is that topographic expression developed since abandonment of the road.

It is not always possible to distinguish between primary and secondary relief; primary topographic characteristics can only be estimated at the present time in most instances because of post-abandonment erosion, deposition, or both. Exceptions occur mainly in areas of sandstone bedrock near cliff edges, where the road was delineated by stone border elements, and where subsurface stratigraphic information has been preserved.

Partial filling is perhaps the most commonly recognizable modification of primary relief. Most road segments have been partially or totally filled by natural processes of wind and sheetwash deposition since the roads were abandoned. Deposition within the roadway is usually accompanied by erosion of border elements or road marginal areas. The net effect of these processes is a subduing of total relief and a "blurring" of the border areas of the roads. Examples of partial filling are demonstrated by stratigraphic profiles of Trenches 1, 6, 7, 9, and 12 (Figure 6-19, back pocket) (see discusssion of trenching program Chapter 6). Trench 7 (Figure 6-19D), for example, contains a stratum of disturbed sediments believed to represent the prehistorically utilized road surface. These sediments, which can be recognized on the basis of depositional structure, texture, and composition, are overlain by 20 cm of post-utilization sediments. In this instance, the road would originally have had more topographic relief than exists at the present time.

In some cases the road may be almost totally filled so that virtually none of the primary relief remains. For example, near Trench 12 on the Penasco Blanco to Ahshislepah Road, the distribution of rocks along the margin of the projected road alignment (Figures 6-15, 6-16, 6-17) indicated that the road had been initially excavated or cleaned to the level of sandstone bedrock, a depth of 10-20 cm. This conclusion was substantiated in trench profile (Figure 6-19G), yet there was virtually no measurable relief on that particular road segment.

In direct contrast to the filling which occurs in some localities, many road segments have been substantially eroded by wind and

water since abandonment. The effects of erosion vary with the dominant process responsible. Wind erosion is usually manifested by substantial widening of the road trace in loose aeolian deposits. Deepening may or may not accompany the widening process.

Erosion by runoff water usually results in a significant deepening of the former roadway, which may be accompanied by widening through sheetwash or wind erosion of the road margins. Ware and Gumerman (1977) report that 6 of 8 prehistoric road segments examined in the Pueblo Alto area contained actively eroding arroyos. Although it remains impossible to measure the exact amount of material removed by erosional processes, losses in some instances were probably substantial. For example, a segment of the South Road, south of Upper Kin Klizhin (Figure 5-1), which parallels the natural slope in that area, has been eroded to the extent that it now is locally more than two m deep. The North Road has been similarly eroded north of Pueblo Alto where it enters Escavada Wash (Figure 5-2).

Vegetation Differential

The presence or former presence of roadways may in some instances be indicated by modified vegetation. Prehistoric roadway vegetation characteristics are highly variable, and no definitive criteria for the use of vegetation for consistent recognition of prehistoric roads have yet been developed.

In some instances, increased abundance of vegetation may indicate the presence of roads (Ware and Gumerman 1977). For example, road segments near Pueblo Pintado are locally delineated by the abundance of sagebrush (Artemesia) growing within the road (Figure 5-3). Ware and Gumerman (1977) report an increase in density of Atriplex canescens in road segments that have been eroded. On the other hand, a decrease in vegetation may characterize some road segments. Ware and Gumerman (1977) indicate a general decrease in vegetation in actively eroding road bottoms as well as in some road margin areas where border elements have significantly modified the natural condition of the substrate.

Increased vigor of vegetation is often noted in and adjacent to roads. Subjective linear observations made during this investigation suggest that pronounced modification of plant vigor is most commonly noticed in areas adjacent to historic roads, whereas concentration of runoff typically results in increased vigor within prehistoric roads.

The reader should be aware that in all the above instances, vegetation modification is controlled by edaphic or topographic factors which may or may not be directly related to the original character of the road. Similar vegetation changes are also associated with depressions formed by entirely natural processes.

Several generalizations may be made about the relationships between roads and vegetation. Those roads having the greatest topographic relief, whether primary or secondary, are most likely to show the greatest vegetation modification. Topographic factors are most likely to be the dominant controls on vegetation in areas of long or steep slopes and in areas of loose sand. Edaphic factors are most significant in stable sediments in relatively flat areas and in areas where a thin soil overlies weathered shale bedrock. With some exceptions, post-abandonment erosion or deposition exerts a greater influence on vegetation than does the original character of the road. Increased bulk density (compaction) of sediments beneath historically used roads tends to diminish plant density within the roadway. Decreased bulk density of sediments beneath partially filled prehistoric roads may facilitate an increase in plant density within these roadways in some instances. Markedly increased vigor of plants adjacent to roads appears to be most commonly an indication of historic use.

Soil Color Differences

It has been observed that sediment colors within the prehistoric roads are different than surrounding sediments. Recognition guides (Obenauf 1980a, Loose and Kemrer 1982) typically indicate that the roads appear darker than surrounding areas. Soil color variations may result from a variety of causes including: increased organic content (darker), increased moisture content (darker), increased density of small annual plants (darker, may appear to be soil color on aerial photographs), post-abandonment sedimentation (usually lighter), and post-abandonment erosion (may appear either darker or lighter).

Natural and Cultural Variables Affecting Visibility

Natural Variables

A wide variety of past and present environmental variables may have a significant influence on both photo and ground visibility of prehistoric lineations in the landscape. The landscape is a dynamic assemblage of land-forms which are the product of a complex interaction of numerous environmental factors, including past and present climate, topographic position, slope, distribution of bedrock and unconsolidated substrate materials, vegetation, and the activities of man. These factors are closely interrelated, and modification of any single factor is likely to be reflected in all other factors.

The effects of overgrazing in an area such as Chaco Canyon provide an example of the interaction of environmental factors.

Figure 5-1. Aerial view of the South Road, looking southwest. Note the deeply incised profile of the road caused by concentration of runoff within the roadway.

Figure 5-2. Aerial view of the North Road looking north from the vicinity of Pueblo Alto. Arrows indicate the North Road alignment, with deeply incised gullying apparent at (A). The Escavada Wash is located at (B).

Figure 5-3. Photograph of prehistoric road from Pueblo Pintado to Chaco Canyon. Visibility is enhanced by the growth of sagebrush between road margins (see brackets).

Overgrazing reduces vegetative cover so that runoff is likely to be more rapid and with higher peak flows. The increase in runoff may lead to downcutting in arroyos, which locally increases the steepness of slopes, thereby accelerating erosion even more. Increased runoff and erosion decrease soil moisture, which may further deplete vegetative cover and ultimately result in a change in species composition. In some situations this may allow wind erosion, and in sandy substrates blowouts and dunes may form. Blowing sand locally further decreases vegetative cover, causing increased sediment yield, and the erosion cycle progressively worsens (Nials 1980). Although overgrazing is cited as the initiating mechanism for erosion in this example, it is important to realize that the same results could develop from changes in total precipitation, periodicity or intensity of precipitation, temperature, wind velocity, farming, tectonic activity, the level of master streams in the area, or various combinations of these and other environmental factors.

Past and Present Climates. Past and present climates control erosional and depositional processes and patterns and the ultimate topographic expression of cultural and natural features developed on the landscape. Past and present environmental characteristics of the San Juan Basin area are only moderately conducive to the preservation of linear features of the landscape such as roads. Although the climate is relatively dry, varying between approximately six and twelve inches (14-29 cm) precipitation per annum, the combination in many places of loose sandy substrate, wind, limited vegetation, occasionally intense "flashy" rainfall, and cold winters which facilitate intense frost heaving of damp sediments all have served to gradually modify the original character of prehistoric roads.

Topographic Position. Prehistoric roads are not uniformly visible throughout the Colorado Plateau. Variations in visibility are, in part, controlled by topographic position (Table 5-1). This is primarily the result of the fact that natural geologic processes operate at different rates in different topographic positions. Dalrymple, Blong and Conacher's (1968) nine-unit land-surface geomorphic model (Figure 5-4) illustrates the effects that topographic position may exert on the nature and intensity of geologic processes. Although designed for an area other than the Colorado Plateau, the model approximates the topography in many parts of the area studied in the project. Aerial photographs (Figure 5-5) illustrate the landscape units and the effects of topographic position in determining road visibility.

Valley Bottoms. Alluviated valley bottoms (Unit 7, Figure 5-4; and Figure 5-5) are, in general, one of the least likely environments in which to encounter visible segments of prehistoric roads. Natural processes of erosion and deposition occurring in valley bottoms almost invariably serve to obscure or destroy prehistoric cultural features, particularly those of a nonstructural character.

Alternating episodes of alluviation and erosion have occurred in most valley bottoms in the southeastern Colorado Plateau during and since the Chacoan occupation. Alluviation has been locally extensive, resulting in burial of Chacoan-age sites and features by as much as 5 m of alluvium near some Chacoan outliers. Alluviation of this magnitude in the vicinity of Chaco Canyon is exceptional, although deposition of a meter or more is common. Radiocarbon and archaeomagnetic dating of hearth materials exposed in an unnamed arroyo near Pierre's Site, for example, indicate local deposition of at least 1.4 m of alluvium since approximately 1045-1075 AD (Windes 1980:14). Features such as this hearth demonstrate the possibility of burial of archaeological features without destruction; however, such burial would obviously diminish or prohibit photo visibility. Burial and subsequent re-exposure of prehistoric roads in a form recognizable to the ground observer is highly unlikely. Road segments having formalized construction features such as masonry walls or rock berms may constitute an exception. As described in Chapter 6, however, it appears that alluvial valleys are not locales where this type of construction is frequently observed.

Local portions of valley bottoms that have not been alluviated in the period since abandonment of the prehistoric roads have usually escaped deposition because of extensive erosion. An erosion potential model (Figure 5-6), based on dendroclimatologic reconstruction, suggests that several periods during and following the Chacoan occupation would have been favorable for extensive gully erosion and/or sheet wash activity (Durand and Nials 1981). Although this model has yet to be totally substantiated in the Chaco Canyon area, studies in areas peripheral to Chaco Canyon suggest multiple Chacoan and post-Chacoan erosional episodes (Nials 1972, 1980).

Colluvial Footslopes. Processes operative on colluvial footslopes (Unit 6, Figure 5-4, and Figure 5-5) usually serve to obscure visibility of prehistoric roads for many of the same reasons as in alluviated valleys. Lower portions of slopes are predominantly characterized by deposition which would be accentuated at the base of those slopes where a road is oriented parallel to the slope and is serving as a conduit for runoff. In this situation, erosion of higher slope areas would result in extensive deposition near the base of the slope, effectively eliminating road visibility from either the aerial or ground perspective. An example of this process is seen near the base of the slope south of Kin Indian Ruin in Figure 5-5. In this area the road or a trace of the road is visible both on upper slope areas and in the alluvial toeslope below, but has been covered on the

TABLE 5-1

PREDICTION MODEL SHOWING THE EFFECTS OF SUBSTRATE TYPE, TOPOGRAPHIC POSITION, AND ROAD ORIENTATION ON PHOTOVISIBILITY[a/]

Topographic Position	Substrate Type					
	Sandstone	Shale	Stable surface-Soil	Aeolian Sand	Alluvium	Colluvium
Valley Bottoms	D[b/]	D	X[c/]	D	D	X
Colluvial Footslopes	X	X	X	D	X	D
Upper portions of slopes	M[d/]	V[e/]	M-E[f/]	V	X	E
Cliff faces-steep rocky slopes	M	X	X	X	X	X
Flat terrain	M	D	M	V	D	X
Orientation						
Parallel to local slope	M	V	E	E	X	E
Perpendicular to local slope	M	D	D	D	X	D
Parallel to local prevailing winds	M	M	E	E	M	M
Perpendicular to local prevailing winds	M	M	M	V	M	M

Notes:
[a/] The predicted effects are generalized and may be altered by numerous factors, especially the primary character of the road. Exploration for previously unknown roads should be concentrated in areas of normally enhanced visibility.
[b/] D-Visibility normally diminished.
[c/] X-Do not normally occur together.
[d/] M-Minimal effects on visibility.
[e/] V-Effects on visibility not predictable.
[f/] E-Visibility normally enhanced.

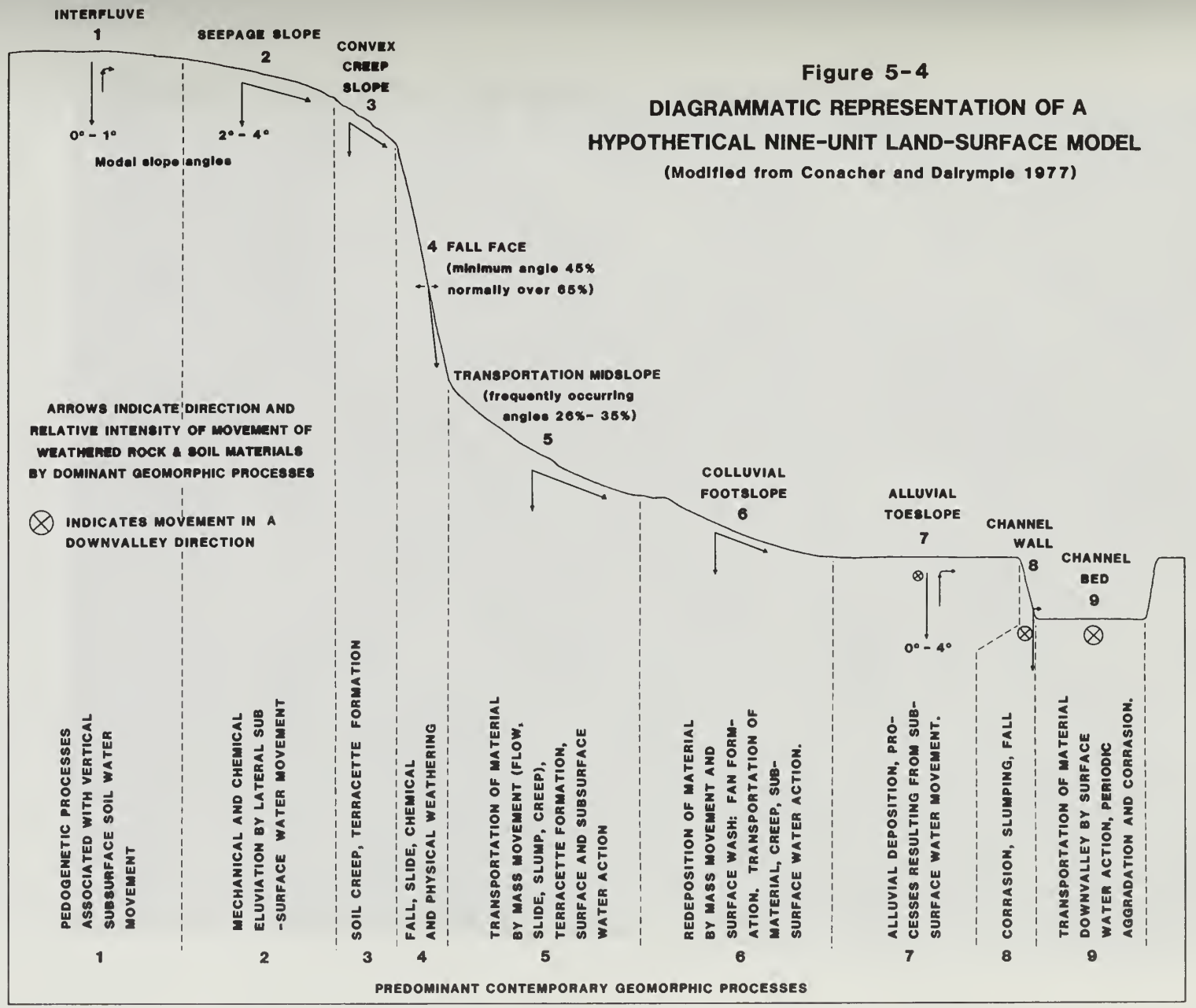


Figure 5-4

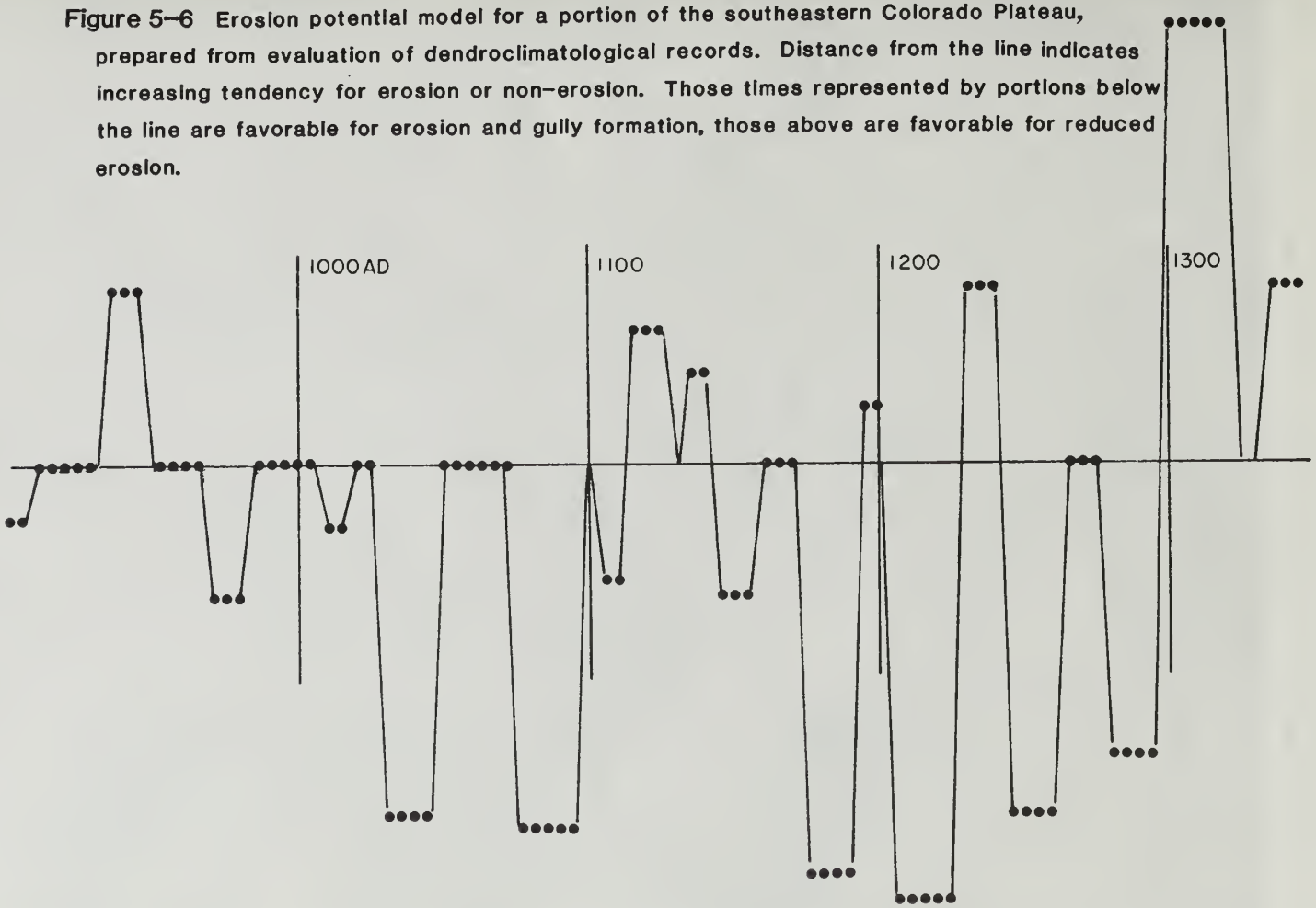
DIAGRAMMATIC REPRESENTATION OF A HYPOTHETICAL NINE-UNIT LAND-SURFACE MODEL

(Modified from Conacher and Dalrymple 1977)

Figure 5-5. Aerial photograph showing landscape elements and substrates discussed in this report. The confluence of the Escavada and Kimbeto Washes is visible in the lower portion of the photograph. A-alluviated valley bottom; B-colluvial footslope; C-transportational midslope; D-convex creep slope; E-flat interfluve; F-fall face; G-active sand dune; H-semi-stabilized dune; I-abandoned historic road; J-Trench 1 location; K-North Road; L-Kin Indian Ruin.

EROSION POTENTIAL MODEL

Figure 5–6 Erosion potential model for a portion of the southeastern Colorado Plateau, prepared from evaluation of dendroclimatological records. Distance from the line indicates increasing tendency for erosion or non–erosion. Those times represented by portions below the line are favorable for erosion and gully formation, those above are favorable for reduced erosion.



(Modified From Durand and Nials 1981)

colluvial footslope and is not visible on either aerial photographs or from the ground. Trenches placed in this area by Brethauer (1978) showed no indications of the road.

Upper Portions of Colluvial Slopes. Convex creep slopes and transportational midslopes (Units 3 and 5, Figure 5-4; Figure 5-5) are areas subject to maximal slope wash. Irregularities in slope or infiltration capacity within prehistoric roads serve to concentrate runoff waters, especially where roads parallel the overall slope. The resultant erosion tends to scour the roadway, increasing topographic expression of the road and enhancing both photo and ground visibility. It should be pointed out, however, that only the trace of the road remains. Erosion could be expected to remove most, if not all, of the actual road surface; the concentrated runoff would be capable of dislocating sizeable objects, making provenience integrity of artifacts found along the roads highly suspect in these areas.

In some areas concentrated runoff has produced an active gully. Ware and Gumerman (1977) report several instances of this on the road systems north of Pueblo Alto. Similar examples may be seen on the North Road just south of Kin Indian Ruin, on the South Road, and in numerous other localities along most Anasazi roads.

Cliff Faces. Prehistoric road segments on cliff faces and steep bedrock areas (Unit 4, Figure 5-4; Figure 5-5) are normally visible only by ground observation or occasionally on extremely low-altitude aerial photography. Road segments in such areas are typically visible only if constructed or formalized in some way. Construction techniques may involve formation of hand-and-toe holds, rock-cut or masonry steps, leveling fills, or ramps of masonry or earthen materials.

Flat or Nearly Flat Terrain. Prehistoric road segments on flat or nearly flat interfluve surfaces (Units 1 and 2, Figure 5-4; Figure 5-5) are extremely variable in visibility. Environmental or cultural factors other than topographic position, particularly substrate type and techniques of construction and maintenance, commonly dictate visibility. In general, relatively flat surfaces are well suited for the preservation of prehistoric linear features, in that flatter surfaces are normally characterized by a relative diminution of erosional and depositional processes. This is to the advantage of the ground or photo observer where the road was originally excavated, delineated, or extensively cleaned. Unfortunately, evidence for extensive construction is minimal in such areas.

Although road segments may not be highly visible in areas of minimal or no construction, those that are visible are of critical importance to the archaeologist. These segments offer some of the best potential for recognition of the former road surface, the study of construction and maintenance techniques and the reconstruction of the original character of the roadway. This was illustrated by Trenches 1, 6, 7, 10 and 12 (Figure 6-19) which were all located in relatively flat terrain, and which all showed either a former road surface or provided information on construction, maintenance, or repair techniques.

Relationship to Local Drainage Patterns. The visibility of prehistoric linear features is also controlled to a large extent by their relationship to the local drainage net. In those instances where a road was located in low areas parallel to, or in the course of, local drainages the road is seldom visible. If the road is still visible, it is usually an eroded trace in which the former road surface has been destroyed by erosion.

Orientation.

With Respect to Local Prevailing Wind. The orientation of the road and its relationship to the prevailing wind may be of particular importance when the road is located on sandy substrates subject to wind erosion (see Table 5-1). In those situations where the road is oriented parallel to the local prevailing wind, the road tends to be scoured by deflation, exaggerating the original dimensions. This may increase both photo and ground visibility of the road trace; however, erosion tends to obscure much of the original character of the road, diminishing the archaeological value of such areas. An additional problem is that narrow linear dunes may parallel the road, greatly increasing the difficulty of photointerpretation.

The effects of aeolian processes are variable in locations where the road orientation is more or less perpendicular to the local prevailing wind direction. Roads may be partially or totally covered by aeolian deposits or, conversely, may be irregularly deflated. Deposition tends to prevail in relatively flat sandy areas and just downwind from major topographic breaks such as mesa and canyon edges, locales where modern dunes are often forming. Burial may, in some instances, be beneficial to future archaeological studies in that rapid burial by aeolian deposits may be conducive to the preservation of primary road characteristics. Deflation is particularly prevalent in some topographic positions, especially near the tops of linear dune ridges (Figure 5-7). These processes may be significantly modified by localized environmental factors such as substrate type, vegetation and position in the topography.

With Respect to Slope. Orientation of linear features with respect to local slope is one of the more important natural environmental factors affecting the visibility of prehistoric linear features (see Figure 5-1). Roads that approximately

parallel the natural slope of an area tend to be readily visible to both the photo and ground observer, especially on a relatively non-sandy substrate; this is due to erosion caused by concentration of runoff waters in the former roadway. It is important to emphasize once again, however, the distinction between visibility and archaeological integrity. Erosion, although possibly enhancing visibility, has a tendency to destroy any original characteristics of the road. Because of the probability of dislocation, the archaeological integrity of any artifacts that may be present is questionable. In general, roads having an orientation perpendicular to local slopes tend to be less visible, although variations exist because of overriding local envionmental factors or original road characteristics.

Substrate Type. Substrate materials greatly affect both photo and ground visibility of prehistoric linear features, primarily because specific geological processes predominate in specifice substrate types (see Table 5-1). Roadways, because of their linear nature and topographic expression frequently accelerate these natural processes. Substrate types, although discussed here from the geological viewpoint, are characterized by specific soils. Table B-1 describes the major soils in the area north of Chaco Canyon, and their characteristics.

Sandy Substrates. Sandy substrates characteristic of stabilized dunes (Figure 5-7), active dunes (Figure 5-5), or other sandy aeolian deposits usually have limited runoff, and aeolian processes of erosion and deposition predominate. These processes may serve to make the roads either more or less obvious, depending upon orientation of linear feature, topographic position, original character of the feature, and other factors.

Prehistoric road segments on sandy substrates are often highly visible from both ground and air in areas that have been selectively deflated along the lineation (Figure 5-7). Except for locating the lineation, deflated visible segments of this type are of restricted utility for archaeological interpretation because the observer is seeing the trace of the road and not the actual road surface or primary characteristics.

Aeolian deposition reduces topographic expression and visibility of the road. Theoretically, however, this deposition should be favorable to archaeological endeavors in that buried portions are protected from destruction by erosion. This is offset by the fact that, in general, sandy sediments are not conducive to preservation and interpretation of roadway features except when constructional features such as masonry are present. In addition, erosion may have preceded deposition in such areas, an event which is not necessarily detectable to even the most discerning observer.

Stable Unconsolidated Sediments. Stable unconsolidated sediments are here defined as those sediments that have been relatively unaffected by the processes of erosion and deposition. Sediments of this type are most typically present in relatively flat terrain (Units 1 and 2, Figure 5-4; Figure 5-5) and are often characterized by the presence of "stable" grasses such as Bouteloa gracilis (blue gramma). These sediments are easily recognized by the presence of soils characterized by an argillic or prominent cambic B horizon. Because of their stability, these substrata potentially present the optimum situation for the recovery of archaeological data pertaining to the original character of the roads as well as to construction and maintenance techniques, etc. (In some instances, however, relatively low infiltration rates characteristic of these substrata could promote runoff which may concentrate within the former roadway.)

Colluvial Deposits. Colluvial deposits are those deposits which tend to be transported primarily by gravity rather than by water or wind, although water may play a part in the transportation process, particularly in slope- and sheetwash. Colluvial deposits tend to be concentrated on the lower portions of slopes (Units 5 and 6, Figure 5-4; Figure 5-5), and road visibility is usually reduced on this substrate material except locally where erosion may predominate.

Bedrock. Shale and sandstone are the most abundant bedrock lithologies within the study area. Shales (Figure 5-5) are composed predominantly of clay minerals, and many of the clays present in shales in the Colorado Plateau are of montmorillinitic composition. These clays are characterized by expansion in volume upon wetting. Frequent expansion and contraction of the substrate accompanying the wetting and drying cycle is extremely destructive to surface features. Also, the extremely low infiltration capacity which characterizes these shales promotes rapid runoff and temporary ponding even with limited precipitation. Roads are almost never visible on bare shale because of excessive runoff, dislocation of surficial sediments by expansion and contraction, and frost activity in standing water. These processes also severely limit the interpretive utility of surficial archaeological materials found along roads on this substrate.

The relative resistance of sandstone to erosion by natural processes and to attrition resulting from use of the road tends to greatly reduce the possibility of development of topographic expression and visibility on this substrate. For this reason roads on sandstone are seldom visible on either

Figure 5-7. Aerial photograph of North Road showing variations in visibility relating to substrate type and orientation. A-stabilized linear dune; B-interdune area; C-prehistoric North Road; D-small drainage; E-historic roads; F-Leo's Hogan Site; G-possible parallel segments. Trench locations: a-Trench 8; b-Trench 13; c-Trench 10; d-Trench 9.

photographs or the ground where constructional features are not present.

Cultural Variables

Several cultural variables may also affect visibility of prehistoric roads. Some variables, such as extent of use and age of road are impossible to evaluate in most cases. Cultural variables pertaining to the primary characteristics of the road may be determined in some instances, but post-abandonment modifications commonly obscure even these. In addition, it should be kept in mind that cultural variables are but one aspect of the environment; their impact on visibility in most instances appears to be overridden by local natural environmental factors.

Extent of Use. The intensity of former traffic on the prehistoric roads obviously can be estimated in only a very general way. Distribution of the roads and road-related sites suggests that the roads probably functioned as a communication network. If this were the case, road segments in close proximity to sites probably received more traffic than those segments further removed from population concentrations. All other factors being equal, this should have resulted in increased visibility of roads near sites. Although this appears to be true in a very general sense, several additional factors must be considered. Until recently the most extensive exploration for prehistoric roads has been in the vicinity of sites or site concentrations. No quantitative road visibility versus distance-to-site studies have been conducted as of the present time. In addition, many of the most visible roads systems (e.g., North Road, South Road, Casa del Rio to Lake Valley Road, Chacra Face Road), are easily visible in areas far removed from major sites. Those segments of roads having a high degree of photo visibility appear to be conditioned in most instances by local cultural and environmental factors, especially substrate type, position in the topography, and construction, rather than by extent of use. Although roads generally do become less visible with distance from major sites in Chaco Canyon, it is not clear that this is due to the amount of former traffic. As of the present, the effects of the extent of use must remain incompletely evaluated.

Age. Roads within the study area fit within three basic age categories: prehistoric roads, historic roads, and prehistoric roads that have been re-utilized within historic times. The significance of age as a factor of visibility is difficult to evaluate. Theoretically, roads should become less visible with age as a consequence of natural geologic processes; however, many highly visible prehistoric road segments still exist, and many historic roads are slightly visible at best. A comparison of documented prehistoric and historic roads suggests that environmental and cultural factors are of far greater importance as determinants of visibility than is age of the road. Age should, in most instances, prove to be a relatively insignificant factor in determining visibility in all but relatively recent historic roads.

Primary Character. Some portions of the Chacoan road network appear to have been either constructed or extensively maintained. Construction and maintenance can assume many forms, including preparation of the road surface (excavation, pecking of steps, etc.), re-excavation of loosened or naturally deposited materials, addition of fill to produce a raised roadbed surface, and addition of border elements such as berms, cairns, or masonry walls. Locally, cultural modification of the road surface and substrate appears to be one of the most important factors determining the visibility of prehistoric roads.

Many prehistoric road segments appear to have been excavated into the substrate (see Chapter 6). This may have been done to expose a more compact substrate to facilitate travel, for purposes of delineation, or as a result of maintenance. Although the original purpose of excavation remains obscure, the effects on visibility are pronounced. Excavation commonly results in the exposure of compact soil horizons, residual gravels, or bedrock in the roadbed. The presence of this linear belt of reduced infiltration capacity, in combination with local modification of topography, causes the concentration of runoff within the former roadway. Subsequent erosion and deposition may result in increased visibility due to modified soil texture or color, modified vegetation characteristics or increased topographic relief (see Figure 5-8). In areas where sandstone or gravel is close to the surface and where surface or subsurface characteristics indicate deliberate excavation, most road segments are easily visible both on aerial photographs and from the ground.

The presence of berms is commonly associated with excavation (see Chapter 6). However, berms are also present in some instances (Trench 1, Figure 6-19) where there is no evidence of excavation within the roadway. Ground visibility is usually enhanced where berms are present because of topographic irregularities, vegetation differential or because of the increased presence of stones within the berm area (Figures 6-15, 6-16, 6-17). Berms are not usually visible on aerial photographs, although low altitude photography sometimes shows the berms as a lighter colored zone on either side of the roadway.

If the berms are rocky in character, a modification of infiltration and drying rates usually occurs, and vegetation is locally modified. Gumerman and Ware (1972) note that vegetation is commonly reduced in the vicinity of berms. In addition, berms can

Figure 5-8. A clearly visible swale located on the Casa del Rio to Lake Valley Road. This segment was probably excavated, and subsequently deepened by erosion.

act as a temporary deterrent to runoff into the roadway causing an increase in vegetation.

Curbs, cairns, and masonry walls are visible only on very low altitude photography, and do not exert any significant influence on the photo visibility of road segments in most instances. In some instances, however, they do significantly alter ground visibility. See Chapter 6 for a more detailed description of these features.

Imagery Factors Affecting Visibility

It has long been a photointerpreter's axiom that one's interpretation is only as good as the imagery allows. This certainly applies to recognition of prehistoric roads in the Chaco Canyon area. Numerous imagery factors may influence visibility and recognition of prehistoric linear features, including the type of imaging system, scale, processing, and timing of photography.

Imaging System

Imaging systems potentially useful in the analysis of prehistoric linear features are of two basic types, photographic (optical) and nonphotographic. Photographic systems record photo-visible portions of the electromagnetic spectrum, whereas nonphotographic systems utilize instruments capable of detecting nonphoto-visible portions. Optical imaging systems are commonly utilized in archaeological studies because of their wide availability and relatively low cost, although nonphotographic systems in some instances have provided useful information not available from standard photography.

Imagery available from photographic systems is typically recorded on black-and- white panchromatic film, black-and-white infrared film, true color, and false-color infrared film. Each of the film types offers advantages in some situations. Most modern black-and-white aerial photography utilizes aerial panchromatic film. This film offers the advantages of relatively low cost, wide availability, good contrast and resolution qualities, and nongrainy character; it is well suited for studies of prehistoric roads, especially in those situations where minor topographic variations along the roads produce shadow marks. The film is less well-suited for detection of subtle tonal variations produced by changes in soils,

plant vigor, and soil moisture.

Black-and-white infrared film is sensitive to a narrow band of infrared radiation, along with red, green and blue portions of the visible spectrum. Currently, no vertical commercial black-and-white infrared imagery is available for areas potentially containing Chacoan roads. This film is more sensitive to vegetation differences than panchromatic film, and reduces haze interference.

True color film is preferable to black-and-white for analysis of environmental factors other than topography. This is because subtle changes in color produced by minor vegetation differences, soil color and texture changes, and variations in soil moisture are more readily detectable in color than on black-and-white film. Depending on the degree of analysis required, however, color film may be prohibitively expensive for the smaller archaelological project.

False-color infrared film detects infrared, red and green portions of the electromagnetic spectrum. This film is especially useful for aerial examination of plant characteristics which often reflect subtle variations in substrate conditions. Thus the visibility of roads should be markedly enhanced during the growing season because of increased soil moisture and drainage characteristics within the prehistoric roadway. No commercial-quality vertical infrared photography taken during growing season is known to be available, although oblique photography of this type (Avery and Lyons 1981:10) demonstrates the efficacy of this film.

Timing

The time at which aerial photographs are taken may have a pronounced effect on the photo visibility of prehistoric roads. Longer-term climatic fluctuations, seasonal or short-term episodic weather events, and the time of day all influence vegetation, soil conditions or length of shadow marks, which in turn, modify photo visibility.

Existing aerial photography does not allow a thorough evaluation of the effects of climatic fluctuations such as droughts or prolonged wet periods. Theoretically, however, climatic fluctuations should affect road visibility mainly through modification of "normal" vegetation characteristics. As a generalization, droughts should accentuate road visibility because of contrasting herbaceous vegetation density and vigor within and outside the road. Road interiors, because of the slight concentration of runoff water within the roadway, should have slightly increased vegetation density and vigor over surrounding areas. Prolonged wet periods potentially would reduce road visibility because of uniformly increased vegetation density both within and outside the road. Seasonal or episodic weather events would also potentially modify the photo visibility of prehistoric roads through vegetation or soil modifications.

Photogeologists have long recognized that sun elevation and azimuth are of critical importance in enhancing minor topographic variations associated with lineations of geological origin. Hackman (1967), for instance, concluded that sun angles of 10 degrees or less above the horizon reveal subtle variations in relief that are otherwise unrecognizable. Studies of geological lineations such as that conducted by Gregory and Moore (1976) clearly demonstrate the improved photo visibility of minor topographic variations in low sun angle conditions. Low sun angle photography has for a number of years been a traditional tool in photogeological lineation analysis. Time of day of photography was also recognized as "an important variable affecting photovisibility of roads" by Ware and Gumerman (1977:138). The potential of low sun angle photography has been discussed by Loose and Kemrer (1982) and Avery and Lyons (1981).

Unfortunately, low sun angle photography other than Landsat imagery was not available for photointerpretation of cultural features in the Chaco Canyon area. Because of this, inexpensive low sun angle black-and-white photography was contracted for this project, imaging various portions of the North Road and the area around Chaco Canyon. The photography, taken by Thomas R. Mann and Associates proved informative beyond our most optimistic anticipations. Extensive comparison of these photos to existing photography (Figure 5-9) revealed several advantages of the low sun angle technique.

A major advantage of the low sun angle photography was the accentuation of minor topographic relief and consequent ease of recognition of linear features. The additional contrast afforded by increased shadow length greatly facilitated initial location of lineations, whether of natural or cultural origin, and whether prehistoric or historic in age. This initial ease of location reduced difficulty of photointerpretation and interpreter fatigue, and minimized interpreter error and overlooking of lineations. As an illustration of this point, Figure 5-10 shows two photographs of a portion of the eastern Pueblo Alto periphery wall. Figure 5-10-1 shows the wall photographed at approximately 7:15 AM late in October, 1981. Figure 5-10-2 shows the same wall, flown at the same scale, taken by the same contractor and camera several days later at approximately 12:00 PM. Although the wall should be located by most photointerpreters on either set of photographs, there is clearly a significant increase in the ease of location on the low sun angle photograph.

In most instances the low sun angle photography did not greatly increase the expanse of previously mapped linear features,

Figure 5-9. Comparison of (1) low sun angle photograph flown for this project with (2) previously flown aerial photograph, showing prehistoric roads in the Pueblo Alto area north of Chaco Canyon.

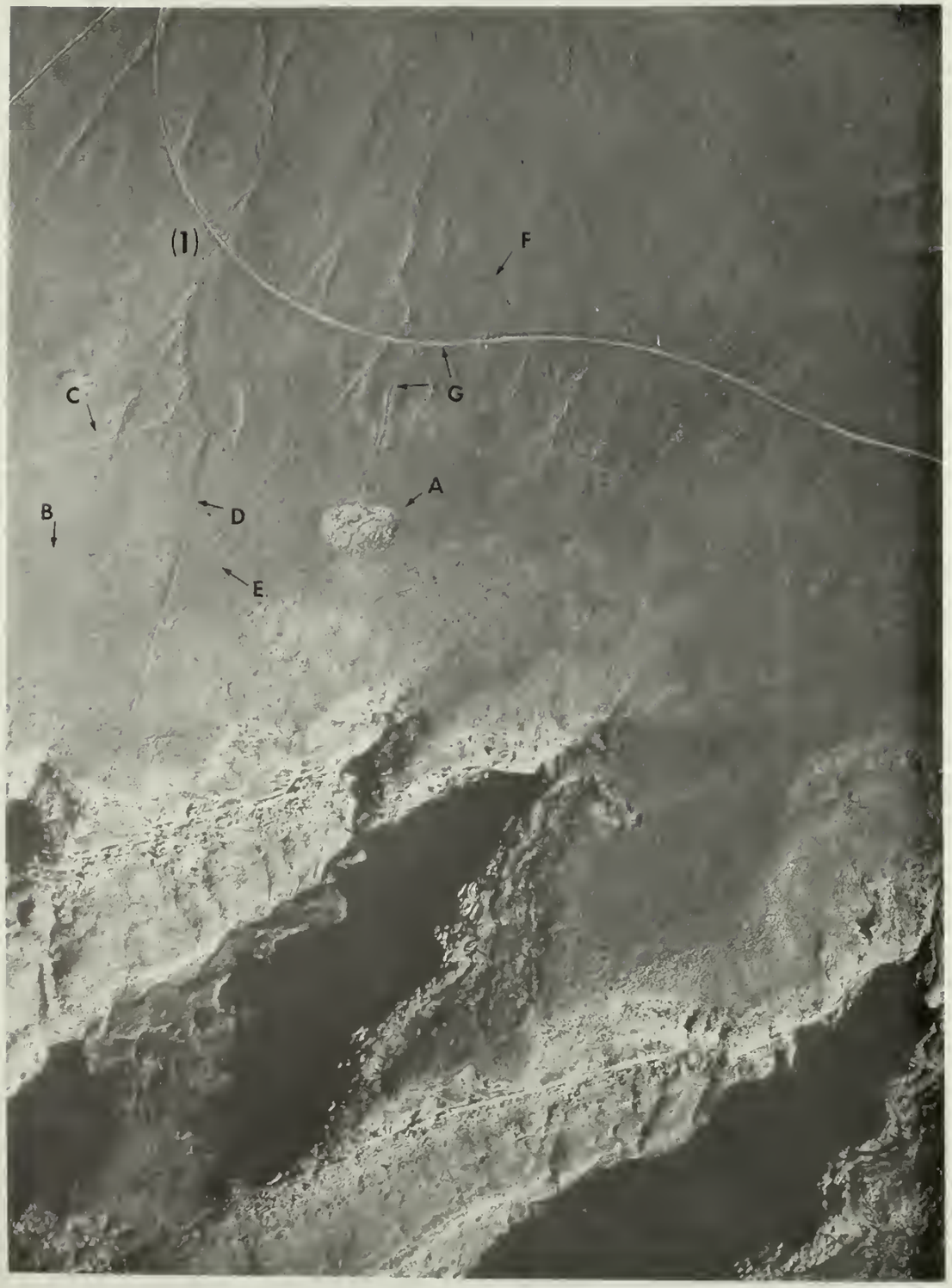


Figure 5-10. Comparison of (1) low sun angle and (2) conventional aerial photographs showing the east wall near Pueblo Alto. The photographs were flown by the same contractor, from the same plane, two days apart. A-gravel pit; B-prehistoric wall trending approximately EW; C-prehistoric road; D-prehistoric wall trending approximately NS; E-prehistoric road; F-Chaco Culture National Historical Park boundary fence; G-historic roads.

although there were some significant exceptions. Previously unrecognized segments or additions to previously mapped segments were observed in several areas along the North Road, as well as in other portions of the Chaco North area (see Figure 4-13). Significantly, most of these new additions were in areas where extremely minor topographic variations were the only photographic criteria for identification. In some instances, these segments were either not visible or barely distinguishable to ground observers (see Appendix A), and would probably have been located only by interpolation of trend or by archaeological content.

Contrast Enhancement

Alternatives to low sun angle photography also exist for improving photo visibility of linear features on aerial photographs and some have been extensively utilized in previous studies of the Chaco Canyon area. Alternatives include contrast enhancement methods such as linear contrast stretch, uniform density stretch, Gaussian stretch, density slicing, edge enhancement and spatial and directional filtering. The interested reader is referred to the series of methodological manuals and supplements published by the National Park Service Remote Sensing Center for a more detailed discussion and analysis of some of these alternative methods (Lyons and Avery 1977, Morain and Budge 1978, Avery and Lyons 1981, Lyons 1981).

Many of the contrast enhancement methods are not practical for traditional low-budget archaeological studies. Most require highly trained technicians and photointerpreters, large initial equipment expenditures, and, in some instances, additional overflights to obtain nontraditional sensing imagery which may be prohibitively expensive. In addition, some of the methods result in a relatively low-resolution image which can produce problems when specific identification criteria are quite minute. This is not meant to suggest that contrast enhancement methods or other remote sensing methodologies are of no value in the study of prehistoric roads, merely that for most archaeological programs traditional photographic methods are more practical.

Guide to Location and Photorecognition of Prehistoric Lineations

Location and identification of prehistoric lineations is a sequential process in most instances, involving initial location and first-order photoclassification, second-order classification of orgin and/or age, and, most importantly, ground verification.

Location and First-Order Photoclassification

Initial location and first-order classification of photolineations is an interpretative process requiring some knowledge of local geomorphology and cultural features, and is most efficiently accomplished on higher-altitude photography having a scale of approximately 1:20,000 to 1:40,000. The larger image areas afforded by these scales offer the distinct advantage of covering large areas of the landscape on a single stereopair, which enables one to better determine relationships of lineations and the landscape.

First-order photoclassification is here defined as the process of initial examination of features observed on aerial photography. This is normally a reconnaissance process, involving preliminary distinction between natural and cultural features. Although some linear features of cultural origin may be precisely identified at the reconnaissance level of observation, this often must be deferred to the process of second-order photoclassification.

Natural lineations may be produced by geologic processes and consequently tend to be located in specific combinations of slope, substrate, and position in the natural landscape. Thus natural lineations such as rills, arroyos, linear dune crests, faults, fractures and dikes tend to have predictable loci of occurrence, directional trends, and topographic expression. Cultural linear features, however, are seldom limited to specific substrate types or landform associations, and their topographic and morphologic characteristics facilitate initial location and preliminary photoclassification of origin.

Loose's (Loose and Kemrer 1982) discussion of Chacoan roads provides a comprehensive discussion of natural and cultural features that can cause linear or curvilinear features on the landscape. Loose identified several major groups of natural features which could conceivably be confused with prehistoric lineations, including lineations associated with geological structures, volcanic, erosional and aeolian features. Most of these features are easily recognized by a trained photointerpreter during first-order classification on the basis of scale, surface character, or topographic expression. Some features, however, could be confused with prehistoric cultural features. Within this group, those of potential significance occurring within the San Juan Basin area include faults, joints, dune patterns, dikes, sills, some types of drainage and erosional features, and some aeolian features.

The following discussion is based on categories listed by Loose (Loose and Kemrer 1982). Categories have been re-arranged slightly to facilitate definition and discussion.

Structural Geological Lineations.

Faults. Most faults can usually be distinguished by their large scale, differences in rock types on opposing sides of the fault, uniformity of topographic expression, high visibility in areas of

resistant bedrock, and drainage alignment along the fault.

Joints. With the exception of displacement, joints have much the same surface expression as faults and could be easily confused with them. Joints are not usually visible except on bedrock exposures, however, and then they usually either parallel cliff faces, or have a uniform spacing and orientation (see canyon edge area, Figure 5-10). Small faults and joints can, in some instances, superficially resemble prehistoric roads and may require second-order observation for positive identification.

Breached Anticlines. Breached anticlines are upward folds of bedrock strata in which erosion along the axis of the fold has removed some material. Linear patterns may exist in some instances, but are usually of a scale so large that little likelihood of confusion exists.

Monoclines. Monoclines are another type of fold in which the bedrock has a unidirectional dip (inclination). Monoclines are too large for confusion with prehistoric roads. Erosion of monoclines typically results in the development of cuestas or hogbacks which may be recognized by their relatively large size, raised topography and inclined resistant bedrock exposures.

Structurally Controlled Drainages or Dune Patterns. The large scale of these features again usually allows relatively easy recognition. Structurally controlled drainages are usually quite large and tend to occur in multiples having parallel orientation. Locally, erosion along small faults or joints may superficially resemble prehistoric roads, especially on high altitude aerial photographs. Easily visible depressions on resistant strata are one of the better clues to recognition. In some instances dunes form along the downwind side of structurally controlled drainages because of increased sediment availability within the drainages. The dunes are easily recognized by topographic expression, ground color and vegetation.

Volcanic Geological Features.

Dikes. Dikes in some instances could be easily confused with prehistoric roads upon initial examination. Several characteristics, however, tend to distinguish dikes. In the Chaco Canyon area dikes tend to be of basaltic composition and usually image as distinctly darker lines in the topography. The dikes tend to be more resistant than the surrounding bedrock and usually form a ridge. Close observation of the image usually reveals darker debris strewn down the slopes of the ridge.

Erosionally Exposed Sills. A sill is a tabular body of igneous rock which has been intruded between layers of rock, usually along bedding planes. These features are usually much too sinuous in outcrop to confuse with roads except for very local instances. In addition, the outcrop of the sill would mimic the outcrop of local bedrock strata and so should be recognizable.

Lava Flows Following Old Drainage Channels. Lava flows or flow remnants of this type may usually be recognized by color, pronounced changes in vegetation, scale (much too large for roads), and raised topographic expression.

Erosional Features.

Various Types of Drainages. Many small-scale erosional features such as rills and shallow arroyos can superficially resemble prehistoric roads on aerial photographs. However, these erosional features tend to be confined to areas of slopes and valley bottoms, tend to be sinuous except on very steep slopes, usually produce a much sharper, well-defined border image than roads, increase in size in a downslope direction, and do not cross drainage divides. Local portions of drainages may be structurally controlled and therefore straight; but with some noted exceptions, these are usually too large to be easily confused with roads.

Differentially Eroded Hogbacks and Cuestas. These can be recognized on the basis of bedrock inclination, topographic expression and size.

Gravel Terraces. It is highly unlikely that terrace remnants would be confused with roads. Terraces can usually be recognized on the basis of topographic position and expression, sinuosity and scale.

Natural Levees. Natural levees do not usually occur on other than meandering, highly developed drainage systems and at the margins of mudflows. They have not been observed on streams in the San Juan Basin, and the scale and sinuosity of such features would inhibit confusion with prehistoric roads. Mudflow levees only occur in areas of relatively steep slopes and have a positive topographic expression which would be unusual for roads in these positions.

Aeolian Features.

Longitudinal Dunes. It is conceivable that some longitudinal dunes (linear dunes of Love 1977) in the San Juan Basin area could be confused with prehistoric roads, at least on a local basis. Characteristically, these dunes have a rather uniform trend of approximately N 69 degrees E, have a positive topographic expression, are usually lighter in color than the surrounding areas, usually occur in numerous multiple parallels, typically have different vegetation than the surrounding areas, and are of a scale too large for confusion with roads in most instances, although the shadowed side of the dune may occasionally superficially resemble a road image.

Transverse Dunes. Transverse dunes are oriented perpendicular to the prevailing wind direction. Dunes of this type are usually

much too large to be confused with roads, are somewhat sinuous, and have a steep slip face on one side.

Dune-Controlled Drainages. Dune-controlled drainages tend to occur in multiple parallel sets, are discontinuous, frequently end in shallow ephemeral "playa" basins, and are usually too large for confusion with prehistoric roads.

Other Geological Features.

Strand Lines. Quarternary lacustrine shorelines could conceivably be confused with roads in some topographic situations and on a very local basis. Strand lines follow the contour of the topography, may form multiple "contours" on hill slopes, are broadly sinuous, do not cross drainage divides (as do roads), and are usually asymmetrical in transverse cross section. In addition, these features are usually of a magnitude too large to be confused with roads.

Facies Contacts. Facies contacts are lateral contacts of strata deposited in different environments. These are not usually a sharp linear contact except in some terrestrial deposits, and may be distinguished by differences in character of the materials on either side of a broad contact, such as color, texture, drainage texture, and topographic expression. Such contacts are not normally straight.

Game and Livestock Trails. Game and livestock trails are too sinuous and too small for confusion with prehistoric roads in most instances. One notable exception sometimes occurs in the vicinity of old Navajo corrals. In such areas, the sheep are sometimes driven along broad, ill-defined "tracks" to grazing areas. The resultant path is often slightly darker in color and locally could be confused with prehistoric roads, especially on higher-altitude photography. These can usually be identified by tracing the "track" back to a historic corral.

Second-Order Photoclassification

The precise classification of age and origin of observed features is normally done in the course of second-order photoclassification. This process usually poses more difficult problems for the photointerpreter, and commonly requires the use of low-altitude aerial photography and high magnification of the image. In some instances classification of age and origin of photolineations may not be satisfactorily resolved by photointerpretation. Those features which typically require second-order interpretation include such prehistoric features as canals and walls, and historic features such as fences, telephone lines, transmission lines, pipelines, plow scars and historic roads.

Prehistoric and Historic Canals. Canals may be more readily identifiable on aerial photographs than on the ground (Table 5-2). On photos, canals are much more sinuous than most prehistoric roads, do not cross drainage divides, approximately parallel land contours, and have a higher frequency of excavated segments than do roads. An example of a prehistoric canal near Kin Bineola is shown in (Figure 5-11).

Prehistoric Walls. Superficial observation of aerial photographs may also lead to the misidentification of prehistoric walls as roads. Closer scrutiny, however, usually reveals several characteristics which serve to distinguish the two. Walls typically appear much narrower than roads, have a positive topographic expression, make right- or obtuse-angle turns, are almost always found in very close proximity to sites, and typically cast a longer shadow than do roads. Aeolian sand is commonly deposited adjacent to the walls.

Fences. Fences often superficially resemble prehistoric roads, particularly along very old fence lines where weeds have blown into the fence. Criteria used for the recognition of fence lines include orientation with cadastral features or historic roads, right-angle turns, a radiating pattern away from historic wells or stock tanks, a change in vegetation or tone from one side of the lineation to the other, cattleguards at intersections with historic roads, and proximity to corrals, houses and other historic cultural features.

Telephone Lines, Transmission Lines. Features of this type could conceivably be confused with prehistoric roads in some instances. Identification criteria include pole shadows, and, frequently, a slightly sinuous historic road in association.

Pipelines. Old pipelines could be confused with prehistoric roads. They possess many of the characteristics of the prehistoric roads, including straight course, little or no modification of course for lesser topographic obstacles, and color change. Most pipelines in the San Juan Basin are of recent enough origin that there is little likelihood of confusion; however, the interpreter should look for association with drill pads, oilfield roads, etc. to ensure correct identification.

Plow Scars. There are few instances in which plow scars could be confused with roads, although some soil conservation methods produce plow scars that superficially resemble prehistoric roads or road margins on aerial photographs. These may usually be recognized by multiple parallel or semi-parallel scars which tend to follow contours and often terminate at a particular vegetative or soil type boundary, cadastral feature or historic road. Plow scars usually appear as light-colored narrow lines, in some instances with a darker-colored border.

Historic Roads. The problem of confusing historic with prehistoric roads has in many

TABLE 5-2

PHOTORECOGNITION GUIDE COMPARING THE PHOTOCHARACTERISTICS OF PREHISTORIC ROADS AND PREHISTORIC CANALS

Prehistoric Roads	Canals (Historic and prehistoric runoff collection and distribution canals)
1. Typically consist of straight segments.	Typically curve with the contour of the terrain. May be straight in areas of very flat terrain and in distribution segments.
2. Typically do not deviate in alignment for minor topographic obstacles.	Must approximately follow the contour of the terrain.
3. Typically have very uniform width.	May vary markedly in width in all but very small cannals and in very flat terrain.
4. Have no direct relationship to arable land.	
5. Have no direct relationship to runoff collection areas.	Must have a source of, and means of collection of, runoff water.
6. Roadcuts are infrequent in most areas.	Cuts are common and often deep.
7. Water-deposited or -sorted sediments may be locally present.	Water-deposited or -sorted sediments are common, especially if the canal is near grade.

Figure 5-11. Low sun angle photograph showing prehistoric canal near Kin Bineola. Note the sinuosity of the canal, compared with the non-sinuous trend of prehistoric roads, as seen in Figure 5-5.

instances been greatly overrated (Flynn 1981), although in some instances the distinction may be locally difficult or impossible to make on the basis of photointerpretation. Table 5-3 is a photorecognition guide comparing attributes of prehistoric and historic roads.

Chapter Summary

Evaluation of aerial photographs and ground exposures of roads have shown that a wide variety of past and present environmental factors may influence the visibility of prehistoric roads. Many of these factors are interrelated, and it is difficult to isolate individual factors without having an appreciation for the total environment of a given area. A highly generalized diagram showing the effects of some of these environmental factors is shown in Table 5-1. An understanding of the relationship between the various environmental factors and road visibility is critical to making informed management decisions concerning the types of archaeological information required to test for the presence of prehistoric roads.

Decisions regarding remote sensing may be among the most crucial for road management. The aerial perspective is normally essential for location, preliminary evaluation and understanding of the roads; the quality of the imagery controls to a very large degree the success or failure of a road management program. The manager must make informed decisions on the type of imaging system to be used, film and processing, time of day, and, if the time frame allows, the season in which the imaging is to be done. Factors which must be evaluated in these decisions include the project budget, lead time for planning project-specific photography, the vegetation community, and local soils and geology. In general, low sun angle black-and-white aerial photographs are among the most readily obtainable and least expensive, and normally provide satisfactory results, although other types of systems may be preferable in some instances.

Frequently the image characteristics of prehistoric roads allow their recognition during first-order photoclassification, although final identification and age assignment should never be made solely on the basis of photointerpretation. A photorecognition guide (Table 5-3) has been prepared to assist in the differentiation between historic and prehistoric roads.

TABLE 5-3

PHOTORECOGNITION GUIDE
COMPARING THE PHOTOCHARACTERISTICS OF PREHISTORIC AND HISTORIC ROADS

	Prehistoric Roads	Historic Roads
Color	Prehistoric roads generally appear darker than surroundings on aerial photographs.	Historic roads that are still in use or that have been recently abandoned are commonly lighter in color than the surroundings. Light-colored road interiors tend to have increasingly less contrast with increased time since abandonment.
Road Margins	Road margins are typically poorly defined on aerial photography. Exceptions exist in some locations because of the original constructed character of the road or because of secondary erosional topographic characteristics.	The edges of historic roads are usually sharply defined on aerial photographs, regardless of scale. The most common exception to this rule occurs in areas of deep sandy substrates, where historic roads may approximate prehistoric roads in appearance in some instances.
Vegetation	Prehistoric roads are not frequently characterized by a pronounced change in vegetation readily visible and/or recognizable on standard aerial photographs. Where photo-detectable vegetation changes do occur, these changes tend to be more within the roadway rather than at the road margins.	Historic roads are commonly characterized by a pronounced change in vegetation along the road margins. Vegetation changes may be in density, vigor or community.
Width	Most prehistoric roads had primary widths of 8-10 m, although the present trace may be as much as 12-15 m wide. Road marginal berms, if present, tend to vary between 2-4 m wide and are seldom more than 20-30 cm high. The road and trace widths may vary, but seldom markedly in areas other than dunes and rocky constrictions.	The width of unmaintained two-track roads is usually not more than 2-3 m, whereas maintained single-lane roads usually approximate 3 m in width and typically possess a berm on one or both sides of the road. Multiple-lane maintained roads vary from approximately 4 m to as much as 10 m in width, the roadbed is typically elevated and has negative or negative-positive border elements. All historic roads may vary in width at topographic breaks, and tend to be much wider in sandy substrates, low areas and in locations where standing water is occasionally present.
Profile	Prehistoric roads frequently have a broad, shallow concave profile. Topography on the prehistoric roads typically is that of a broad shallow concavity. Exceptions occur in some localities, mainly in areas of extensive erosion.	Historic roads are commonly rutted especially in areas of low infiltration capacity. Ruts may or may not be visible on photographs, depending on scale of the photography.
Runoff Concentration	In those instances where prehistoric roads serve to concentrate modern runoff, the resultant feature is typically a relatively broad, shallow arroyo or swale which in some instances meanders slightly.	Historic roads often serve as a focus for modern runoff. Arroyos commonly form in historic roads, which are unnatural in width, position in the topography, relationship to other "natural" arroyos, and straightness.

Road Course	Prehistoric roads usually do not make major deviations in alignment in steep areas. Exceptions occur at some cliffed locations. Although not usually visible on aerial photographs, such major deviations in course are usually accompanied by the presence of delineation features such as walls, steps, cairns, marker stones, etc. Visible portions of prehistoric roads usually consist of a series of straight segments. Minor course adjustments usually occur in topographically high positions such as ridgetops. Contrary to most previously published information, some prehistoric roads do curve, usually as in a broad sweeping arc. The only place tightly curved segments were observed was in the vicinity of cliff faces.	Historic roads are geomorphic and commonly digress from course in areas of extremely steep topography such as cliff faces, rocky areas and modern arroyos. These roads usually surmount steep areas at an angle oblique to the direction of slope to maintain grade or facilitate access. Frequent changes in course of historic roads gives these roads a decidedly sinuous or winding appearance in most instances. This tendency ~~is less~~ pronounced on some multiple-lane maintained roads, but is still quantitatively demonstrable in most instances. The most common exceptions are where roads are oriented to cadastral features (e.g., section-line roads), power line roads, and pipeline and oilfield roads and scars.
Relationship to Historic Roads and Features	Prehistoric roads in some instances may appear to intersect with modern roads, but intersection is often at an unnatural angle with no provision for turning. Historic sites may be adjacent to prehistoric roads, but stratigraphic principles indicate that the juxtaposition is meaningless in the absence of a termination at the historic site.	Abandoned historic roads frequently may be followed to a juncture with a currently used road or to multiple junctions with other abandoned segments. In many instances, the actual juncture of the two roads may not be visible, but the presently used road makes an angle change at the projected juncture. This evidence must be used with caution, inasmuch as documented historic re-use of prehistoric linear features does exist. Historic roads often terminate at, or have spur roads going to, historic features.
Terminations	Prehistoric road system "terminations" are usually at prehistoric sites.	Road terminations may show turnarounds.
Valley Bottoms	Prehistoric roads are almost never visible on alluvial valley bottoms because of post-utilization erosion and/or deposition. Prehistoric roads make no obvious digression of course for modern arroyos.	Historic roads are usually visible on alluvial valley bottoms except in the actual channel. Historic crossings of arroyos are often distinquished by indications of road maintenance, crossing modifications or by increasingly arcuate multiple roads emplaced in an attempt to avoid headward erosion.
Modern Features	Modern features such as dams, roads, fields, etc. are superposed on or obscure the prehistoric roads.	Historic roads may cross or incorporate "modern" features such as dams and cultural modifications to drainage or landscape.

CHAPTER 6

CHAPTER 6

PHYSICAL CHARACTERISTICS OF CHACOAN ROADS

The study of physical characteristics of Chacoan roads had multiple objectives, including the analysis and classification of road elements, development of a standardized terminology for roads and road elements, and the refinement of our understanding of road variability through the techniques of subsurface trenching. It was anticipated that examination of the physical characteristics of roads would allow the formulation of a recognition guide facilitating the on-ground differentiation between historic and prehistoric roads. It was also hoped that analysis of physical characteristics of roads would assist in determing the degree of engineering and construction involved in the development of a road system, which could potentially provide a basis for estimating the labor investment required for road system construction and maintenance. This information is relevant to larger archaeological questions about the functions of road systems, the role and relationship of road systems to a complex society, and the organization of the society itself.

Field Observations

Not all portions of the known or supposed Chacoan road network were examined for this study. At the present time, approximately 100 miles (160 km) of possible prehistoric roadway have been photointerpreted within Chaco Culture National Historical Park, and an additional 300 miles (480 km) outside of the Park. Of this 400 miles (640 km) of possible prehistoric road systems, only 35 miles (55 km) were examined on the ground in detail for this project.

An additional 60 miles (100 km) were examined by means of aerial photography of various types and scales. Ground and photo observations were concentrated mainly on the North Road, Penasco Blanco to Ahshislepah Road, South Road, South Gap road complex, Rincon (Latrine) Road, Chacra Face Road, Pueblo Pintado to Chaco Canyon Road and numerous segments of apparently shorter roads in the Chaco North area (Figure 4-1). Because of limitations of time and practicality, there was heavy reliance in many instances on descriptions made by other investigators, including initial field descriptions and preliminary reports which were graciously provided by R. Gwinn Vivian and various members of the Chaco Center.

Past and present environmental characteristics in the San Juan Basin area are only moderately conducive to the preservation of linear features such as roads. Although the climate is relatively dry, the combination in many places of loose, sandy substrate, windiness, limited vegetation, sometimes intense, flashy rainfall, and cold winters which facilitate frost heaving of damp sediments have all served to gradually obscure prehistoric roads. In addition, intense overgrazing, especially during the late 1800s and early to mid-1900s resulted in erosion which further obscured these features.

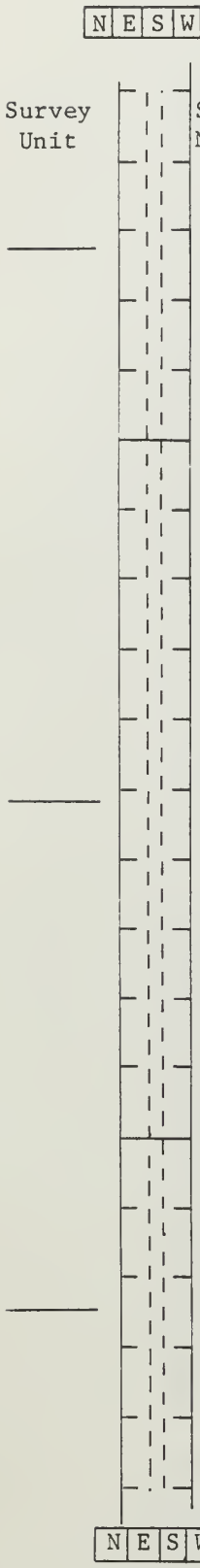
Shortly after the project began it was recognized that some standardized method of describing specific portions of road segments was needed to ensure uniformity in approach and to assist in the distinction between historic and prehistoric roads. A classification system of road characteristics was therefore devised to provide a basis for the interpretation of primary characteristics and degree of secondary modification of the roads.

Geological processes which modify the roads tend to result in a distinctive road morphology. The classification system, which is based on road morphology, leads to an understanding of both the nature of the processes which have modified the road and the extent of modification. Determination of the extent of modification is also facilitated by an analysis of the geological environment of the roads. This analysis is best done by a trained geologist, but much important information can be collected by archaeologists with a minimum of geological training as well. As a means of assisting in the uniform collection of information on the physical characteristics of roads and their environmental setting, a Visible Segment Form (Figure 6-1) was devised.

Information contained in the Visible Segment Form provides a basis for communication between the archaeologist and geologist, may reduce costly geological consultant time, and assists in assessing the information potential of visible segments and in selecting segments to be trenched. Codes for the classification system followed in this form are presented in Figures 6-3, 6-7 and 6-12. Each of these is discussed separately in the following narrative. It should be noted that while the form is intended for use from the perspective of the ground surface, it pertains to a classification system for road traits which at times may only be visible from the subsurface perspective (e.g., road surfacing). The situation is similar to estimating room counts for archaeological sites using surface indications only. Subsurface observation can provide new information which may alter conclusions based on survey data. Field recorders using the Visible Segment Form should keep in mind that these limitations are understood.

The descriptions of morphological characteristics of Chacoan roads which follow in this chapter are based primarily on ground examination of weathered and eroded surface exposures. Although trenching was done in

PHYSICAL CHARACTERISTICS OF ROADWAY
GROUND OBSERVATIONS



VISIBLE SEGMENT FORM NUMBER: _____

Road Name: _____

Survey Unit: _____

Subsegment Number: _____
(Fill appropriate segment of survey unit(s) at left)

Topographic Quadrangle: _____

Aerial Photograph Number(s): _____

General Location: Sec(s). _____, T____N, R____W,

UTM Location:

Beginning of visible segment:

_____N, _____E

End of visible segment:

_____N, _____E

Photographs taken: ____ Yes ____ No

Photograph numbers: _____

Other pertinent information:

Suggested linear Scale:
1 cm = 100 m
If another scale is used, designate scale:
1 cm = _____

Recorder: _____

Date: _____

Figure 6-1. Visible Segment Form used to record environmental and physical characteristics of road segments visible to ground observers.

ENVIRONMENT

General setting

_____ Butte
_____ Mesa top
_____ Mesa or canyon edge
_____ Cliff or bluff
_____ Rolling upland hills and valleys
_____ Badlands

_____ Alluvial fan
_____ Former floodplain
_____ Present floodplain
_____ Sand dunes
_____ Alternating sand hills and small drainages
_____ Other (specify)

_____

Vegetation

Number the following types of vegetation in order of their abundance

_____ Snakeweed
_____ Sagebrush
_____ Grasses
_____ Saltbush
_____ Greasewood
_____ Juniper
_____ Annuals
_____ Other (specify)

_____

Is roadway vegetation different than surrounding area? _____ No _____ Yes If yes, describe below:

Substrate

Unconsolidated sediments or soil

_____ Dune sand
_____ Active dunes
_____ Stabilized dunes
_____ Stable surface
_____ Colluvium
_____ Alluvium

If unconsolidated sediments or soil is less than approximately .5 meter in thickness, what is the bedrock type beneath the sediments?

_____ Shale
_____ Sandstone
_____ Gravel

Other (specify) _____

Bedrock exposed at the surface

_____ Shale
_____ Sandstone
_____ Gravel
_____ Other (specify): _____

Slope characteristics

How determined: _____ Ground measurement _____ Topographic map

Overall slope: _____ ° Variation: _____ ° (max) to _____ ° (min)

Approximate length of overall slope: _____ meters

Approximate orientation of slope: N S _____ ° E W

Figure 6-1 (continued).

Approximate condition of slope (estimate obtained by looking across the slope)

_____ Surface shows numerous irregularities parallel to direction of slope
_____ Surface shows occasional irregularities parallel to direction of slope
_____ Surface shows virtually no irregularities parallel to direction of slope

Physical Characteristics of Roadway

_____ Imaged segment visible on ground
_____ Unimaged segment visible on ground

Approximate length of visible segment: _____ m. Orientation: N S _____ E W

Erosion within roadway:
_____ Appears strongly eroded
_____ Appears somewhat eroded
_____ Appears uneroded

Erosion agent:
_____ Wind
_____ Water
_____ Human activity

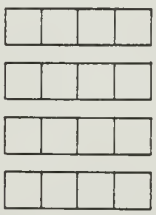
Road profile: (see drawing on following page)

_____ Negative topographic expression
_____ Positive topographic expression

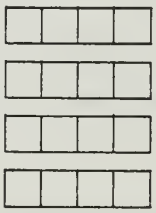
Representative depth of swale or height of rise _____ m
Representative width of swale or rise _____ m

Road morphology classification:

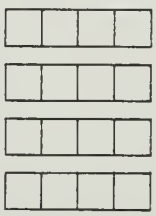
Longitudinal Profile



Transverse Profile



Border Elements



Approximate Height _____

Approximate Width _____

Is road oriented to a landmark on the distant horizon?

_____ Yes _____ No _____ Distant horizon not visible

If yes, name or describe:

Is road oriented to a landmark on the near horizon?

_____ Yes _____ No

If yes, name or describe:

Figure 6-1 (concluded).

this project to verify surface observations, the survey archaeologist in many instances will not have access to this type of information. Consequently, where possible, descriptions are oriented to ground recognition of surface characteristics. A comparison chart showing surface characteristics of prehistoric and historic roads is presented in Table 6-1.

The following discussion concentrates on those road characteristics which are related to disturbance of natural deposits, which modify ongoing natural processes of erosion or deposition, or which are of such an origin as to require only minimal archaeological interpretation. Thus many possibly road-associated features noted by other investigators (e.g., Morrison 1973 and Hitchcock 1973) such as rock circles, rock art, sharpening grooves, shrines, sites, ceramics, burned areas, hearths, work areas, overhangs, etc., will not be discussed here. Those aspects of road-associated cultural features beyond the scope of geological interpretation are discussed elsewhere in this report.

Ground observations were usually initially directed by interpretation of aerial photography. Road segments previously mapped by Obenauf (1980a) were examined on the photographs to determine the range of variability and "normal" conditions of roads in different environmental settings. Road segments that appeared distinctive because of photosignature, proximity to sites, topographic position, topographic modification of either natural or cultural origin, or substrate type were selected for preliminary ground investigations, in addition to large segments of more typical roadway.

During the ground observation process such characteristics as width and depth (profile morphology), border elements (berms, curbs, walls, etc.), and degree of post-abandonment erosion and/or deposition were noted, along with the geomorphological setting and presence of any features or objects not of natural origin. A number of locations on both prehistoric and historic roads were selected for trenching, stone counts or other detailed studies.

Virtually all initial ground observations were made in conjunction with project archaeologists for the purpose of comparing and contrasting observations and interpretations. In addition, many prehistoric road segments described by previous investigators were re-visited to calibrate observations, assess the types of information previously recorded, and ensure some measure of standardization of terminology. A special effort was expended in examination of known historic roads to determine their physical characteristics and recognition criteria.

Road Width

Width is one of the more consistently mentioned characteristics of the prehistoric roads. Various widths have been reported, ranging from 2.5 m to 12.6 m (Holsinger 1901, Lyons and Hitchcock 1977). In general, reported widths of individual road segments or linear features now thought to be road segments may be separated into several major groupings: 1) eleven m or greater (Hastings 1960, Ware and Gumerman 1977, Irwin-Williams 1973b); 2) seven to eleven m (Vivian 1964, Vivian 1972, Loose 1974a, Ware and Gumerman 1977, see also Appendix A); 3) seven m or less (New Mexico Highway Journal 1928, Vivian 1972, Marshall et al. 1979, see also appendix A). In addition, some linear features originally thought to be canals but now thought to be roads, may be included in the second category [Vivian 1964; Lancaster 1979: personal communication (cited in Woosley 1980); see also Appendix A].A variety of factors may account for the observed range in variability of width of prehistoric roads, including proximity to sites, type of road, "normal" variations in construction, delineation or utilization patterns, topographic position, secondary modification of the roadways, and method of measurement.

Proximity to major sites is clearly a factor in original road width. Most reported widths exceeding 11 m, where locations are given, are in the vicinity of sites. This greater width is not from gradual widening through attrition, for most roads in these locations also tend to be more formalized and possess construction or cleaning features such as berms, curbs, walls, etc. The primary width of the roads is also apparently a function of road "type" in that "primary" roads connecting major sites tend to be wider, averaging approximately nine meters in width (Vivian 1972). More localized "spur" roads are only approximately half this width (Vivian 1972).

Minor variation in reported road widths is probably the result of normal primary variations in construction, delineation or utilization through time. More significant variations in width, especially localized narrowing, are often found at topographic impediments to travel. In most areas of steep terrain the roads are frequently significantly narrower than in topographically unimpeded locations, often narrowing to a width of less than two m.

Secondary processes of erosion and deposition also significantly affect the width of Chacoan roads. Secondary modification of the roads generally tends to increase the apparent width of the observable roadway to some degree, and results in uncertainty as to the original edges of the road. In the absence of recognizable border elements or trenches profiling the roadway, it is often difficult or impossible to determine the

TABLE 6-1

COMPARISON OF GROUND-RECOGNITION CRITERIA FOR PREHISTORIC AND HISTORIC ROADS[a/]

Prehistoric	Historic
Width - Surface trace is typically 8-10 m, although occasionally wider or narrower.	Machinery-maintained roads may be 10 m or rarely wider. Non-maintained roads are typically 2-3 m or slightly wider.
Longitudinal Profile - Most commonly is terrain-following, although cut, fill, and cut-and-fill profiles are occasionally present.	Cut, fill, and cut-and-fill profiles are common on machinery-maintained roads, absent on non-maintained roads.
Transferse Profiles - No topographic expression - Common.	Common on older and little-traveled roads.
Negative Topographic Expression - Shallow Symmetrical	
a. parabolic - Common.	Relatively common on older historic roads and those roads on sandy substrates.
b. angular - Not known to exist.	Common on machinery-maintained roads, absent on others.
c. rutted - Not known to exist.	Common.
d. gullied - Occasionally present.	Common.
Negative Topographic Expression - Shallow Asymmetrical	
a. regular - Often present on eroded or partially filled roads.	Often present.
b. leveling - Uncommon.	Common.
c. gullied - Moderately common.	Common.
Negative Topographic Expression - Deep Symmetrical	
a. parabolic - Present in some locations, mainly on sandy substrates and on colluvium near the base of slopes where the road parallels the slope.	Often present on heavily traveled roads, especially those not machinery-maintained.
b. angular - Not known to exist.	Common on machinery-maintained roads.
c. rutted - Not known to exist.	Common.
d. gullied - Occasionally present.	Moderately common.
Negative Topographic Expression - Deep Asymmetrical	
a. regular - Occasionally present.	Occasionally present.
b. leveling - Uncommon	Common
c. gullied - Occasionally present.	Moderately common

TABLE 6-1 (Concluded)

Positive Topographic Expression - Low Symmetrical	
a. parabolic - Rare.	Common on machinery-maintained roads, not known to exist on others.
b. angular - Not known to exist.	Common on machinery-maintained roads, not known to exist on others.
Positive Topographic Expression - Low Asymmetrical	
leveling - Uncommon.	Common on machinery-maintained roads, not known to exist on others.
Positive Topographic Expression - High Symmetrical	
a. parabolic - Uncommon.	Common on machinery-maintained roads, not known to exist on others.
b. angular - Not known to exist.	Common on machinery-maintained roads, not known to exist on others.
Positive Topographic Expression - High Asymmetrical	
Uncommon, usually has retaining wall on downslope side.	Common on machinery-maintained roads, not known to exist on others.
Positive-Negative Topographic Expression	
Only known from one location at the present time.	Common on machinery-maintained roads, occasionally present on others, usually in combination with a retaining wall.
Berms - Berms are only occasionally present on prehistoric roads. When present, the berm rarely consists of just earthen materials. The berms are usually stony, and occur where bedrock or lag gravel is close to the surface. Width-height ratios are commonly 20:1 or greater on prehistoric roads, although ratios are occasionally lower.	Berms are common on machinery-maintained roads not having negative border elements; roads having a berm are most commonly about 3 m in width. The berm often consists of non-stony materials, but may have stones. A berm may be found on most substrates except sandy (with the exception of very modern roads). Width-height ratios of 2:1 to 20:1 on the berm are common.
Presence of Artifacts in the Road and Immediate Vicinity	
Artifacts (mostly ceramics) are not extremely abundant in most places but are not rare.	Historic artifacts are not common, but are almost always present. Pre-1930s artifacts are rare.

a/ See also Table 5.

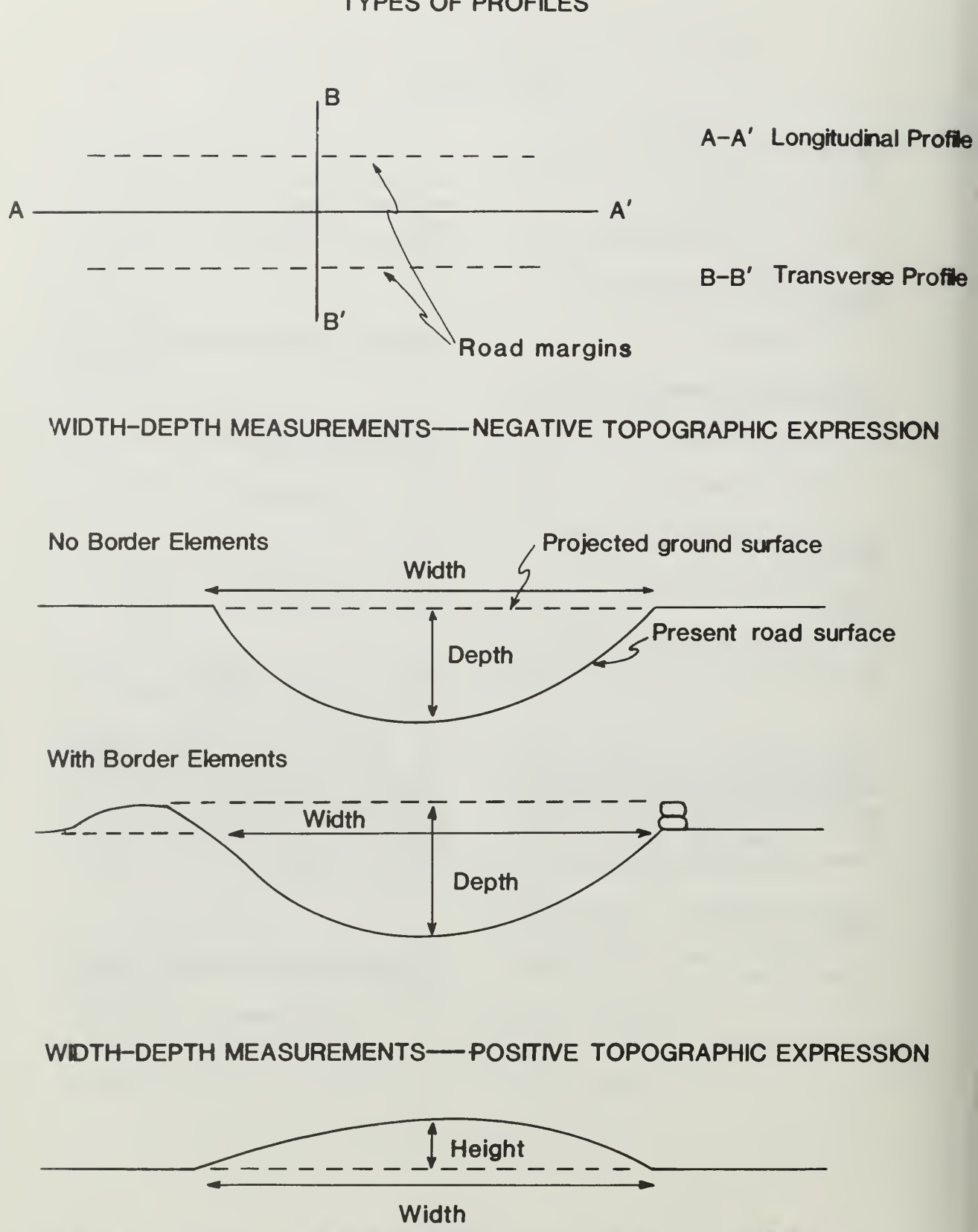


Figure 6- 2 Schematic diagrams showing the types of road profiles, and the methods of measurement of width, depth , and height of prehistoric roads.

precise width of the former road. This difficulty leads to inconsistency in measurement, which may account for some of the reported variations in width. Lyons (1973:12a and b) reports the roads "were next to impossible to get accurate measurements for. Boundaries of the road were apparently obliterated by erosion, making it difficult to tell (what) points we could use as reference points for measurement." Gwinn Vivian (Appendix A) reports similar difficulties in some instances.

Where definable border elements or stone concentrations are present the road width is here defined as the distance between inside edges of border elements (Figure 6-2). Where there are no recognizable border elements, the width is defined as a representative distance between the break in slope on either side of the roadbed depression. Measurements of this type should only be made in relatively level terrain and in areas which have been excavated into hillsides. Measured road widths will normally be in excess of the primary width, however there is no alternative method of measurement available.

Despite variations in road width of either primary or secondary origin, most investigators consistently report road widths of 8-12 m where topography is not a consideration. Measurements made during this study showed that in structurally or topographically unimpeded localities these widths are typical, as indicated by surface depressions, stone counts and subsurface profiles. It must be mentioned, however, that most measurements made during this investigation were from road segments outside the Park boundaries, and away from Bonito Phase structures of large size. No roads fitting the description of Gwinn Vivian's (1972) "spur" roads were examined in detail for this study.

The function, physical necessity or social requisites of such wide roads in a society lacking wheeled vehicles are not understood at this time, although similarly wide prehistoric roads are reported from other societies and geographic areas. Beck (1979) reports similar or greater widths on roads of similar character in the Moche Valley of coastal Peru, as do Trombold (1976) and Wiegand (1978) on otherwise physically dissimilar roads near Zacatecas, Mexico.

Road Elements

Four basic road elements were recognized in the road element classification: 1) longitudinal profiles, 2) transverse profiles, 3) border elements, and 4) the primary roadbed. Of these elements, longitudinal profiles, transverse profiles, and border elements may usually be described from surface observations, albeit imperfectly. The fourth element, the primary roadbed, is not normally visible from the surface, and only occasionally in excavations; consequently no means of recording primary roadbed characteristics is provided on the Visible Segment Form (Figure 6-1).

Longitudinal Profile. The longitudinal profile is a cross-section along the linear axis of the road (Figures 6-2, 6-3, 6-4). The purpose of examining this profile is to show the relationship of the road to the unmodified terrain surface and to describe any surface modification which may have been done to alter the grade of the road. A series of ordered adjectives may be applied to longitudinal profiles to make descriptions more precise. First-order modifiers (divisions) are based on the relationship of the road to topography. Two divisions are recognized, terrain-following (ungraded) and graded.

LONGITUDINAL PROFILES

1. Terrain-following (100)
2. Graded (200)
    1. Cut (210)
    2. Fill (220)
        1. Leveling (221)
        2. Causeway (222)
        3. Ramp (223)
    3. Cut-and-fill (230)

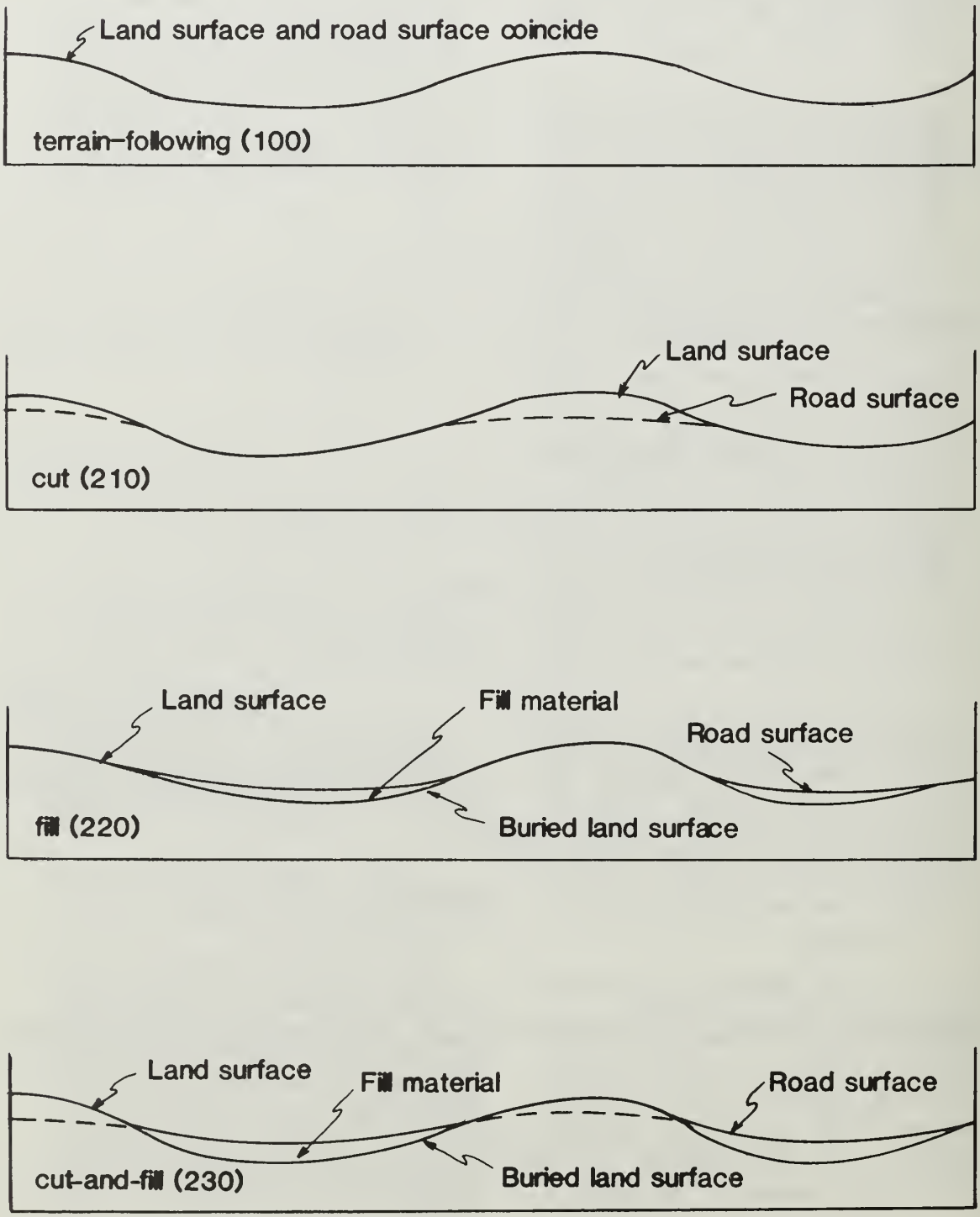
Figure 6-3. Proposed classification of longitudinal profiles of roads. Numbering is arranged to facilitate computer coding of forms.

Terrain-Following. Terrain-following profiles are those in which essentially no modification of slope has been made, and the surface of the road and the original ground surface are approximately the same (Figure 6-4).

Graded. Graded roads may be further subdivided, based on the nature of modification, into three classes: 1) cut, 2) fill, and 3) cut-and-fill.

CUT. Cut profiles (roadcuts) are those in which material has been excavated from topographic high points to lessen the grade of the road (Figure 6-4). Although not common on prehistoric roads, many road cuts have been observed, e.g., along the South Road, South Gap road complex, Chacra Face Road, Penasco Blanco to Ahshislepah Road, and North Road (Vivian 1972, Lyons 1973, Marshall et al. 1979, Hayes 1981). One of the better examples of roadcuts is seen in South Gap, approximately 75 m north of LA 41809. Another cut may be seen in Section 27, T. 20

Figure 6-4. Schematic diagrams showing the various types of longitudinal profiles.



N., R. 11 W. (South Road), where a small sandstone knob was cut for some unknown reason.

However, care must be utilized in determining whether a "cut" is intentional or not, for secondary processes of erosion typically are concentrated in the same topographic positions where road cuts are excavated. Secondary processes have likewise often altered intentional road cuts, making recognition from surface observation difficult. To avoid mis-identification, a road depression should be designated a cut only if the excavated materials from the cut have been placed at the borders of the cut or in some other position adjacent to the road causing a recognizable berm. This conservative approach may result overlooking some intentional road cuts, but also avoids the potentially more serious problem of exaggerating the amount of construction on the roads.

FILL. Fill profiles (Figure 6-4) are those in which material has been brought in from elsewhere to fill topographic depressions, presumably for the purposes of leveling or raising the roadbed or modifying grade. Those profiles having no topographic expression except for border elements do not qualify as having a fill profile. Three classes of fill profiles have been recognized: 1) leveling, 2) causeways, and 3) ramps.

LEVELING. Leveling fill is applied to sloping surfaces where the road course is perpendicular to local slope for the purposes of providing a level road surface. Although producing a longitudinal fill profile (Figure 6-4), it is best illustrated in transverse profile (Figure 6-11) (Hayes 1981, Figure 32). Leveling fill, though not common, is present in several areas near cliff edges at the margins of Chaco Canyon (Holsinger 1901, New Mexico Highway Journal 1928, Hayes 1981, Appendix A this report). One example of leveling fill may be seen between Pueblo Alto and Chetro Ketl, and another, possibly not road-related, is in the first rincon to the east of Chetro Ketl (Hayes 1981).

The fill material may or may not be retained on the downhill side by walls or other forms of border elements; however most observed examples of prehistoric leveling fill observed have possessed some form of defining retaining border element. Road profiles of this type may be indicative of a large prehistoric labor investment. Most leveling fill on historic roads has not been retained by a formal border element.

CAUSEWAYS. As utilized in this report, a causeway is defined as a raised roadbed in which both sides of the roadbed project above surrounding terrain (Figures 6-4, 6-11). Descriptions of prehistoric causeways from other areas of the world typically indicate the presence of some form of retaining wall, although this is not considered here as a characteristic. Some variability in meaning of the term "causeway" is indicated by previous descriptions of roads or road segments in the Chaco Canyon area. Some investigators have apparently used the term synonymously with a road or highway, for example Gordon Vivian (1964) described a "37-foot-wide causeway" some 1.6 miles in length west of the confluence of Escavada and Chaco Washes (Penasco Blanco to Ahshislepah Road). Irwin-Williams (1973b) apparently utilized the term similarly when she described Chacoan roads as 20-40 foot wide causeways, bordered by ditches and/or mounds. Others have apparently utilized the term "causeway" to mean a raised, walled road. Lyons and Hitchcock (1977:123) describe a "causeway" associated with Pueblo Alto: "The configuration of the walls with flagstone paved surfaces in places and their direct alignment with road segments and stairways suggest that they were part of the roadway system and served as causeways not unlike the Mayan sacbeob." It is recommended that these alternative definitions not be utilized in future descriptions of Chacoan roads.

Two of the few unquestionable causeways reported on Chacoan roads are found near Penasco Blanco, where a low fill has been emplaced to raise the roadbed in two low areas. One of these, an arroyo crossing, had masonry borders two feet high and was 12 feet long and 6 feet wide (Lyons and Hitchcock 1977:125). The other apparently had no border elements and contained rock and soil fill (Lyons and Hitchcock 1977). Height probably did not exceed several feet on either of these features.

Caution should be exercised when appending the name causeway to slightly elevated features along either the visible or projected alignment, for several natural features can be similar in appearance to constructed causeways. Material eroded from, and transported along the roads is commonly deposited within the roadway, and in some instances may be easily confused with intentional fill. This may occur along roads which parallel the local slope. These roads often serve as a focus for runoff, which deposits sediments near the base of the slopes, forming small alluvial fans. These fans may be narrow, parallel the trend of the road, and may superficially resemble intentional fill. In the absence of border elements, excavation may be required to conclusively demonstrate the origin of these features.

Natural features other than alluvial fans may also be similar in appearance to causeways. For example, a presumed causeway (LA 34301) was buried beneath alluvium near Pierre's Ruin. The "causeway" consists of deposits of pebble gravels which grade into tabular cobbles and small boulders over a distance of approximately 60 m. The tabular materials have the appearance of an adobe-stone wall with some coursed masonry. Upon closer examination, however, it may be seen that the

"causeway" is a remnant of a rocky colluvial apron mantling a bedrock hill which existed prior to incision of the modern arroyo (Figure 6-5). Examination of similar rocky aprons on other hills in the area showed that the colluvial deposits attain maximum thickness near the base of the slope, and that coarser material is concentrated in the base of individual depositional episode sediments. The colluvial deposits become thinner and finer in texture toward the distal ends of the deposit. The geometry of the "causeway" deposits fits the described geometry of colluvial deposits.

Several other characteristics argue for a colluvial origin of the "causeway":

1. "Causeway" deposits contain a relatively high percentage of rounded chert and quartzite pebbles, as well as cobbles and angular petrified wood fragments, which are common components of lag gravels mantling bedrock surfaces in the area, and which would be expected to be concentrated in colluvial deposits.

2. Tabular sandstone cobbles and boulders in the deposit are identical in character to bedrock outcrops higher on the slope above the arroyo (Figure 6-5).

3. The deposit locally grades in places into an almost pure alluvial pebble and cobble gravel.

4. The horizontal orientation of tabular sandstone cobbles and boulders which resembles coursing is not uncommon within other, clearly colluvial, parts of the deposit and is to be expected.

5. The non-sorted, crudely stratified or non-stratified nature of the "causeway" deposits is characteristic of colluvium.

6. At the time the "causeway" sediments were deposited, the channel was, at a minimum, several tens of meters east of its present position, effectively eliminating the need for a causeway in that location.

7. Stratigraphic relationships (Figures 6-5, 6-6) argue for a late Pleistocene to mid-Holocene age of the deposit, preceding the Chacoan occupation by at least 4,000 to 5,000 years.

The intent of the above discussion is not to argue against the very real, though not common, presence of causeways, but rather to interject a note of caution in the identification of any raised or apparently raised feature as being a causeway.

RAMPS. Ramps have been noted on at least 11 sites within Chaco Canyon (Hayes 1981). All of the ramps are reportedly associated with roads. They are usually at the foot of a stairway, and consist of an earth, rock or rubble fill held in place by a masonry retaining wall and a natural cliff face. Ramps are commonly built upon a natural rubble or talus slope, thus decreasing the amount of fill required. They usually terminate well below the cliff top and Vivian (Appendix A) effectively suggests that ramps served as platforms for ladders surmounting the cliff face. Dimensions of the ramps are variable; Vivian (Appendix A) describes two of the better-known ramps, Bc-86 and his feature B-3, as being over ten and twenty-seven m in length, respectively. The masonry walls were probably in excess of one m in height on Bc-86 and 1.5 m in height on B-3. Both ramps had widths within the range of Vivian's (1972) primary roads.

CUT-AND-FILL. This class (Figure 6-4) is a combination of the previous two classes; it occurs where the road course is perpendicular to the trend of closely spaced ridges and valleys. Cut-and-fill profiles are most often found near major sites or in close proximity to Chaco Canyon. Holsinger (1901) described cut-and-fill profiles on Chacoan roads and they were also observed on several roads during this investigation, including the Chacra Face Road, South Gap road complex, and South Road. It should be noted that the presence of a roadcut does not necessarily imply a cut-and-fill profile, for the material excavated from the cut may have been placed adjacent to the road, rather than in a low place within the road alignment. Perhaps the best example of a cut-and-fill profile may be observed in Section 23, T. 21 N., R. 11 W.

Transverse Profiles. The transverse profile is a cross-sectional profile oriented perpendicular to the trend of the road segment (Figures 6-2, 6-7, 6-8, 6-9, 6-10, 6-11). These profiles reflect the present surface topography in the area of the roadway and not necessarily the primary topographic expression of the road. They often are of utility in determining the extent of construction, erosional and/or depositional history, and, in some instances, the relative age of the road. A transverse profile description is valid for a very localized area of the road only, for the cross-section profile of the road may vary considerably within a short distance and it is conceivable that a given road segment may exhibit several different types of profiles. It is recommended that recorded profiles be 50 m in length, approximately centered on the roadway, to obtain maximum information return.

Four divisions of transverse profiles may be recognized, based on topographic expression: 1) no topographic expression, 2) negative topographic expression, 3) positive topographic expression, and 4) positive-negative topographic expression. Two of the four divisions of transverse profiles are by definition limited to only one form of topographic expression and could only be encountered in specific topographic positions. Because of this fact, the two divisions (no topographic expression and positive-negative topographic expression) require no ordered modifier to refine their

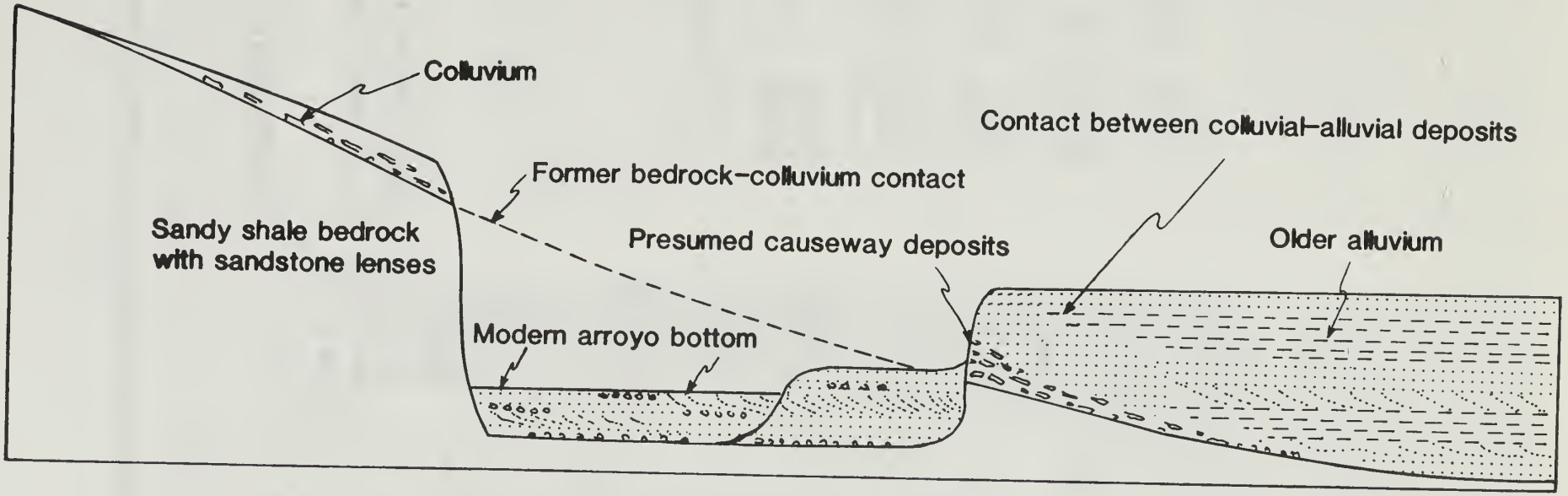


Figure 6–5. Schematic cross–section showing the stratigraphic and topographic relationships of the Pierre's "causeway" deposits.

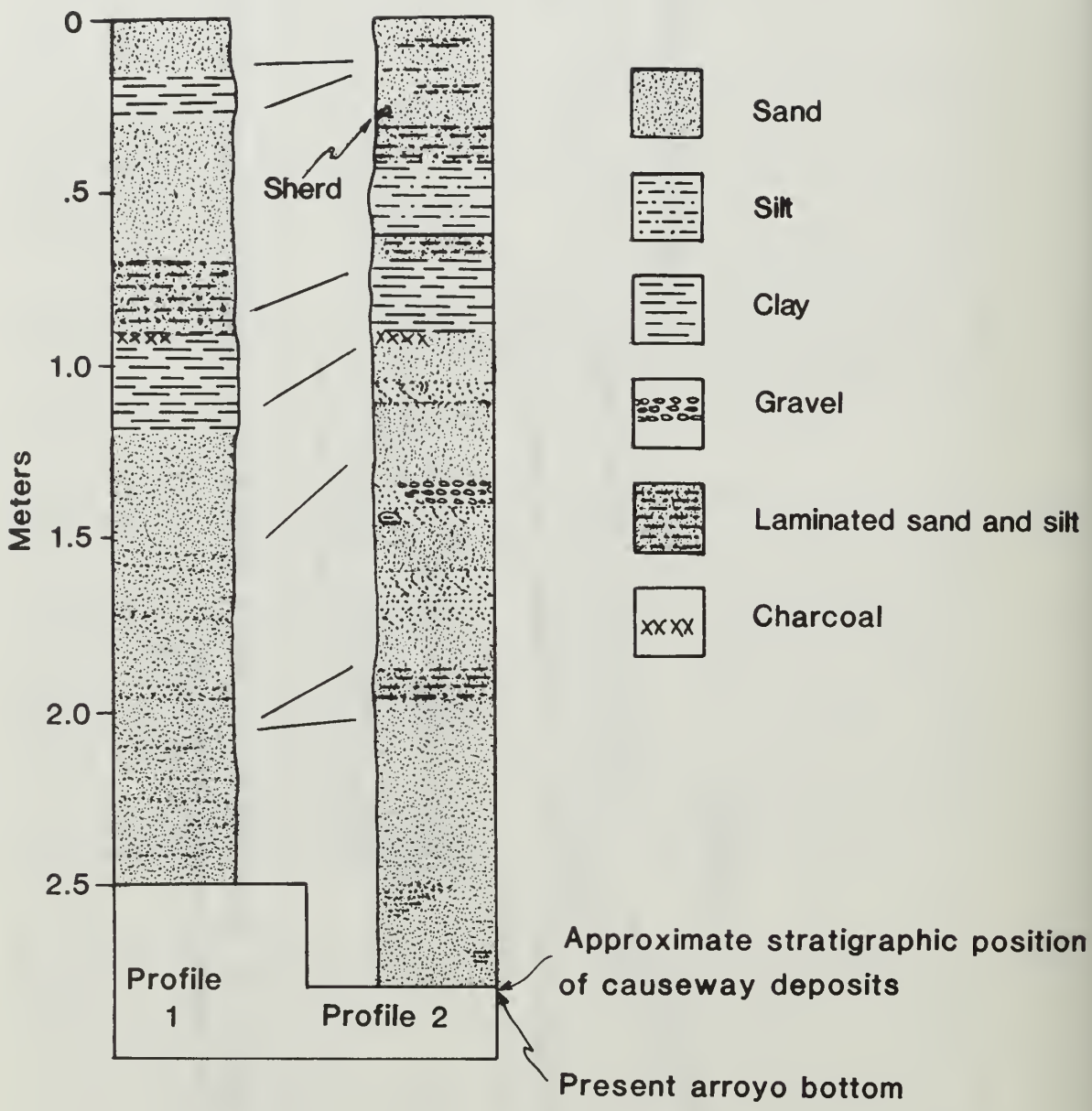


Figure 6-6. Alluvial stratigraphy near Pierre's Ruin "causeway".

TRANSVERSE PROFILES

1. No topographic expression (1000)

2. Negative topographic expression (2000)
    1. Shallow (2100)
        1. Symmetrical (2110)
            1. Parabolic (2111)
            2. Angular (2112)
            3. Rutted (2113)
            4. Gullied (2114)
        2. Asymmetrical (2120)
            1. Regular (2121)
            2. Leveling (2122)
            3. Gullied (2123)
        3. Other (2130)

    2. Deep (2200)
        1. Symmetrical (2210)
            1. Parabolic (2211)
            2. Angular (2212)
            3. Rutted (2213)
            4. Gullied (2214)
        2. Asymmetrical (2220)
            1. Regular (2221)
            2. Leveling (2222)
            3. Gullied (2223)
        3. Other (2230)

3. Positive topographic expression
    1. Low (3100)
        1. Symmetrical (3110)
            1. Parabolic (3111)
            2. Angular (3112)
        2. Asymmetrical (3120)
            1. Leveling (3121)
        3. Other (3130)

    2. High (3200)
        1. Symmetrical (3210)
            1. Parabolic (3211)
            2. Angular (3212)
        2. Asymmetrical (3220)
            1. Leveling (3221)
        3. Other (3230)

4. Positive-Negative topographic expression (4000)

Figure 6-7. Proposed surface classification of transverse profiles. This classification is based on the presently visibile character of the road, and does not necessarily reflect the primary morphology of the road. Numbering is arranged to facilitate computer coding of forms.

definition. Transverse profiles of roads having either negative or positive topographic expression, however, may be further characterized by second-, third-, and fourth-order modifiers. The divisions are defined as follows:

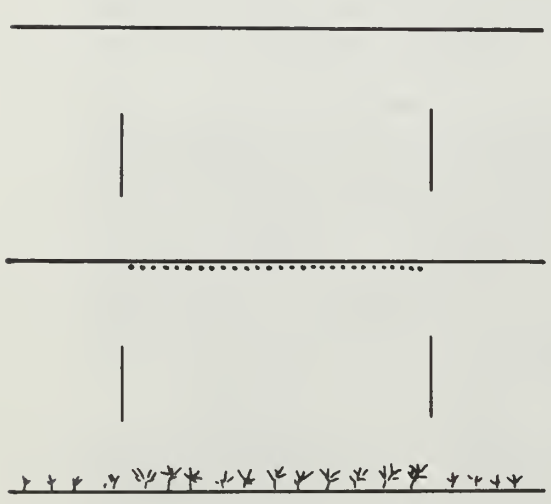
No Topographic Expression. The road surface and extra-road ground surface or border elements are coincident (Figure 6-8) for roads within this division, so that the roads cannot be recognized on the basis of morphologic characteristics. Unfortunately, this is the most common profile for prehistoric roads. Absence of topographic relief may indicate a lack of primary relief and construction, or the presence of secondary filling or erosion of the road to the point of obliteration. An example of secondary filling may be seen in the Section 29, T. 22 N., R. 11 W., where only linear stone concentrations indicate the former presence of the road. Although not further subdivided into classes on this basis, roads with no topographic expression may sometimes be recognized by differences in surface texture, soil color, or vegetation.

Negative Topographic Expression. These are profiles in which the present road surface is below adjacent land surfaces or border elements (Figures 6-9, 6-10). Many prehistoric road segments possess this type of profile. Negative topographic expression may be the result of either primary or secondary processes. Information from trench profiles and the presence of border elements indicate that some portions of the Chacoan roads were excavated; however, numerous other locations can be shown to possess negative relief as a result of erosion.

Classes of this division are based on the present depth of the roadway (Figure 6-2). Two classes of roads having negative topographic expression are recognized, shallow and deep. Shallow profiles are those in which the deepest detectable portion of the existing roadway surface is less than 35 cm below a line from road margin to road margin, including border elements. Deep profiles are more than 35 cm deep below a line from road margin to road margin, including border elements. The distinction between deep and shallow is obviously arbitrary. The selection of 35 cm as the dividing point is, however, based on numerous measurements of visible roadway depressions, and the fact that roads more than 35 cm deep are visible from the ground to most viewers under most conditions of lighting. Roads less than 35 cm deep, however, may not be visible under some lighting conditions. Deep profiles are most commonly found in roadcuts, at the crests of narrow ridges, in sandy areas (particularly dune crests), and on long slopes where runoff is concentrated in the roadway. The location of shallow profiles is less predictable, although they are most typically found on sandy substrates and on long slopes. Both shallow and deep profiles may indicate either construction or erosion.

Third-order modifiers of roads having negative topographic expression are based on the symmetry of the cross-section profile (Figures 6-9, 6-10). Two categories are recognized, symmetrical and asymmetrical. The measurement of profile symmetry indicated by category names is not meant to be extremely precise. The profile should be considered to be symmetrical if the cross-section even approximates symmetry; however, if one side of the defined roadway is markedly deeper than the other, the profile is to be considered asymmetrical.

NO TOPOGRAPHIC EXPRESSION



POSITIVE–NEGATIVE TOPOGRAPHIC EXPRESSION

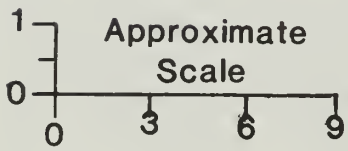


Figure 6–8. Schematic diagrams showing transverse profiles of No Topographic Expression and Positive–Negative Topographic Expression.

NEGATIVE TOPOGRAPHIC EXPRESSION

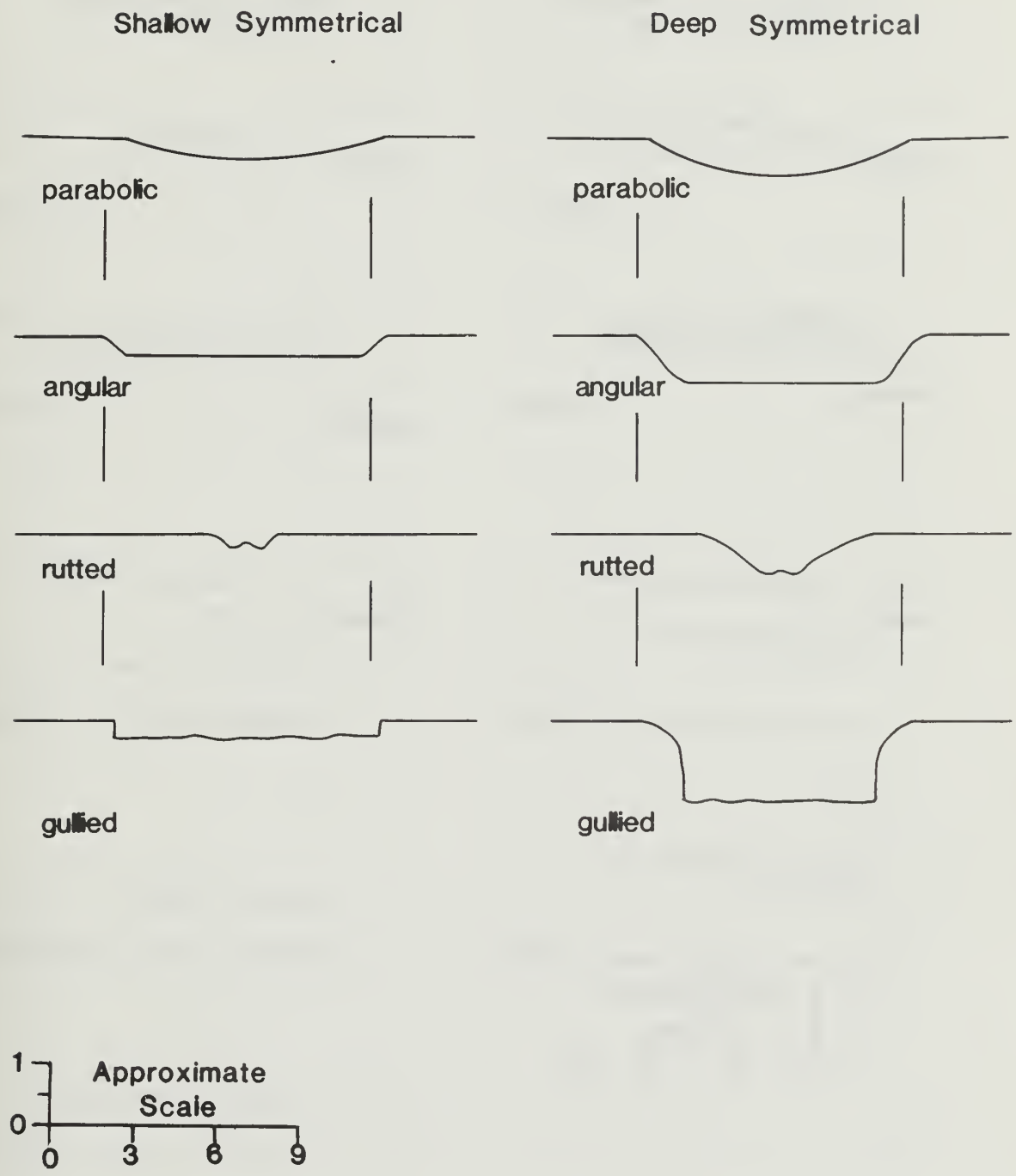


Figure 6-9. Schematic diagrams of Negative Topographic Expression, Shallow and Deep, Symmetrical transverse profiles.

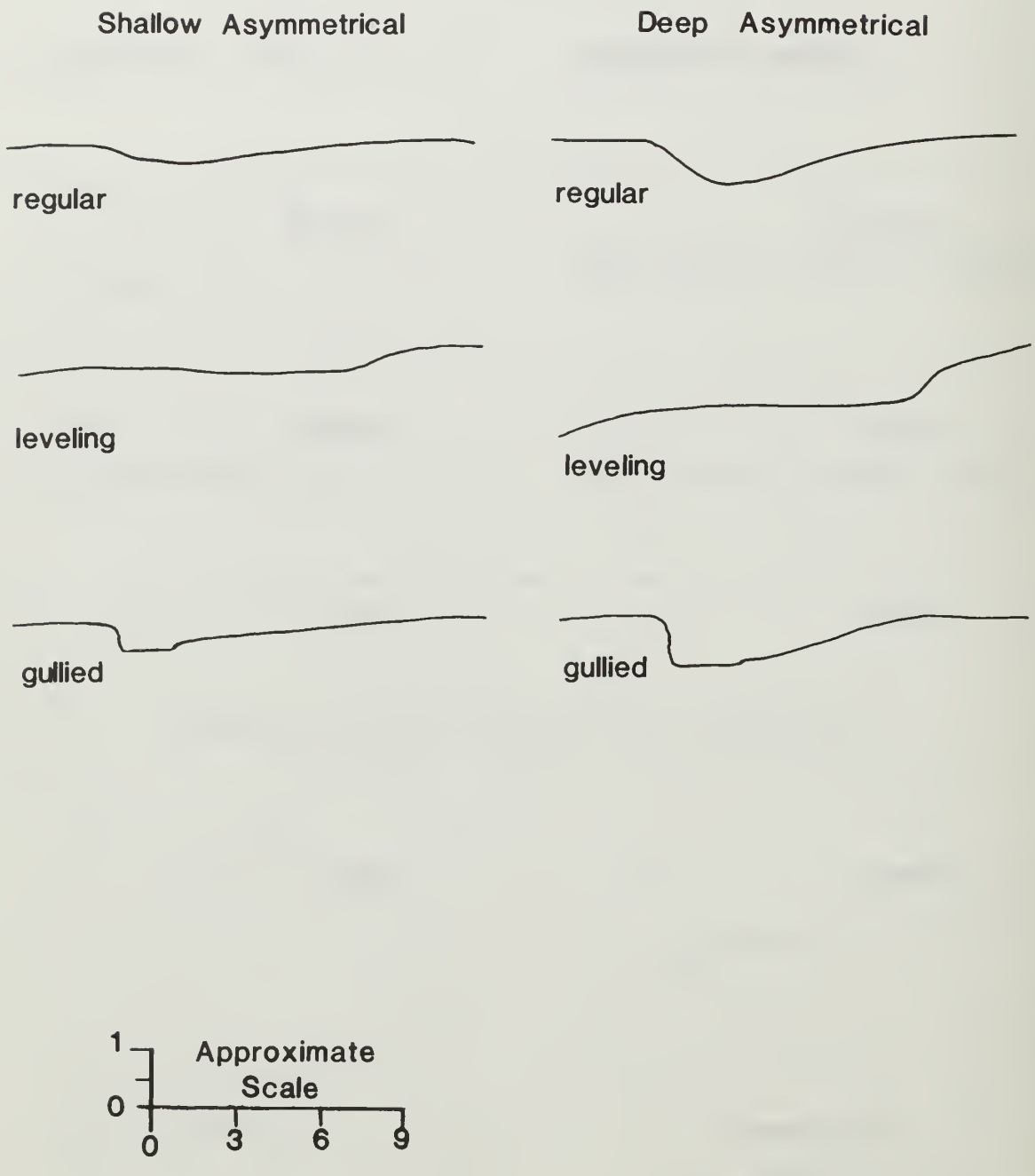


Figure 6–10. Schematic diagrams of Negative Topographic Expression, Shallow and Deep, Asymmetrical transverse profiles.

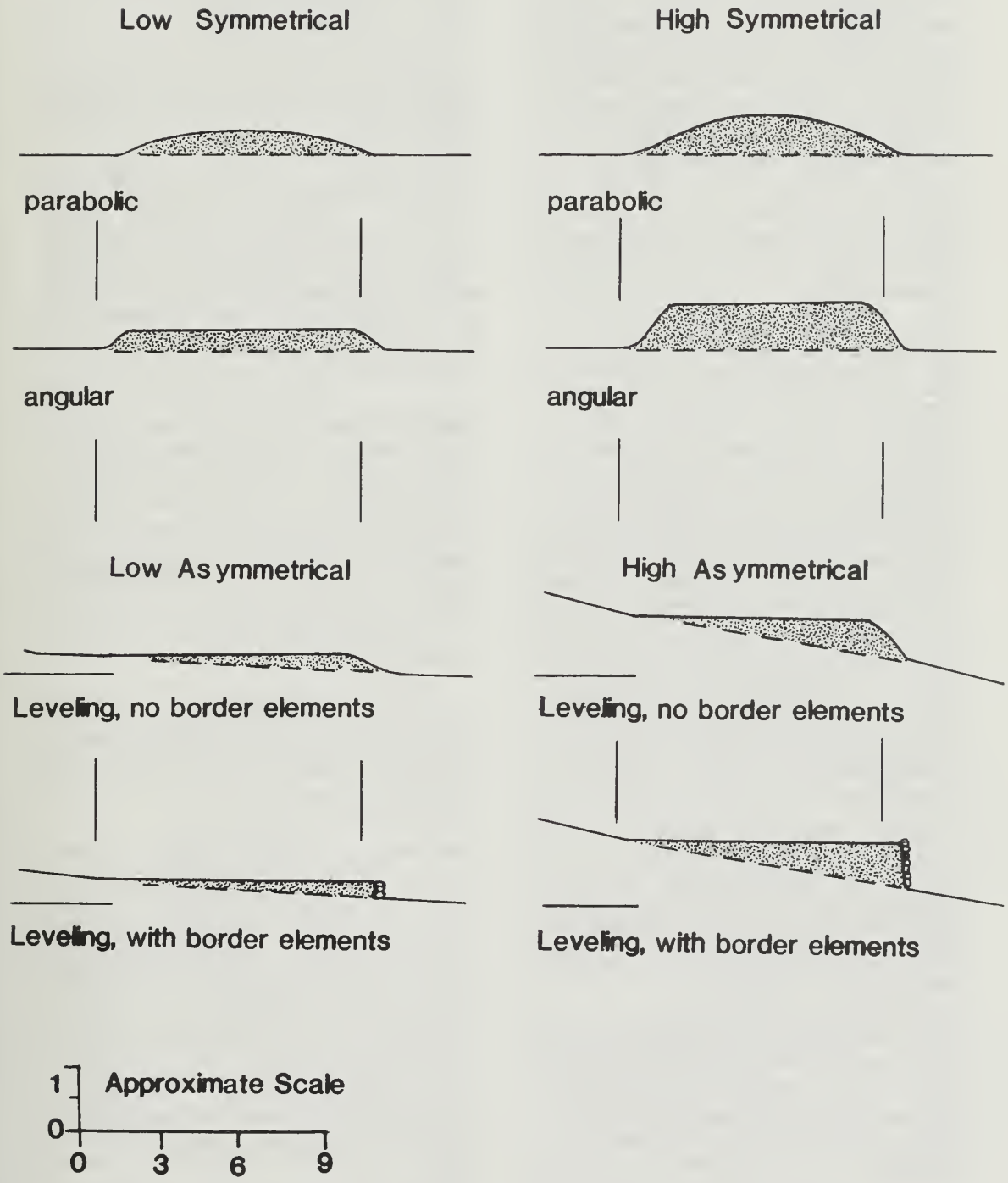


Figure 6-11. Schematic diagrams of Positive Topographic Expression, Low and High, Symmetrical and Asymmetrical transverse profiles.

Although admittedly imprecise, the distinction between symmetry and asymmetry is potentially quite important in evaluating the nature and extent of construction and/or secondary modification of the road.

Symmetrical profiles tend to indicate uniformity of secondary processes, i.e., lack of concentrated runoff. This "uniformity" does not necessarily indicate that primary characteristics of the road remain, although the probability of encountering primary road characteristics in subsurface excavations is, in general, thought to be much greater on road segments having symmetrical profiles. An exception to this generalization is the case of gullied symmetrical profiles. A gullied profile usually precludes any information recovery except for the road location. Gullied profiles typically are most pronounced on prehistoric roads having historic reuse, such as the North Road between Escavada Wash and Pueblo Alto (see Figure 5-2).

Markedly asymmetrical profiles normally indicate either primary construction characteristics or a high degree of modification by secondary processes. Roads which parallel slopes often have an asymmetrical profile because of runoff concentration and gully development eroding material from the downslope side of the road. Conversely, in areas of active or stabilized dunes, an asymmetrical profile may indicate deposition of aeolian sands into the road. In this situation, the deeper part of the profile will typically be on the downwind side of the profile. Asymmetrical profiles on roads which are perpendicular to the local slope may indicate either erosion or deposition or both. The uphill side of the road may be partially filled by colluvial and low-level alluvial activity, whereas runoff tends to be concentrated on the downslope side of the road, at least locally. Thus symmetry of transverse profiles may, in some instances, provide a preliminary clue as to the intactness or secondary modification of the road segment being examined.

Fourth-order modifiers (Figures 6-9, 6-10) are based on other characteristics of the shape of the cross-section profile which may indicate age or character of topographic modification of the roadway. Four types of symmetrical and three types of asymmetrical profiles have been recognized. Symmetrical profiles may be described as parabolic, angular, rutted, or gullied.

Parabolic cross-sections are typically very broad catenary curves indicating relatively minor secondary modification of the cross-section profile. Symmetrical prehistoric roads almost invariably have this shape. Parabolic profiles are thought in most instances to indicate relatively unconcentrated secondary processes, although there are many exceptions.

Angular cross-sections are those in which non-masonry road elements are markedly angular in character. Articulated masonry border elements are arbitrarily excluded from this type, and should not be interpreted as imparting an angular character to the roadway. Angular cross-sections are typical of prepared modern roads, and would probably not occur in unpaved prehistoric roads having negative topographic expression.

Rutted roads possess two or more sets of parallel depressions which are produced by wheeled vehicles. These roads are typically less than 3 m in width and are obviously modern in origin.

Gullied symmetrical transverse profiles are, as the name implies, characterized by the presence of a gully in the bottom of the road. Relatively few prehistoric roads would fit into this category, for most gullies in roads are much smaller than the roads they occupy, are concentrated on one side of the road, and would be classed as asymmetrical. As previously mentioned, portions of the North Road between Escavada Wash and Pueblo Alto could be classed into this type.

Three types of asymmetrical profiles are described: regular, leveling and gullied. Regular asymmetrical profiles are produced by deposition into or erosion from one side of the roadway and do not normally reflect primary characteristics of the road. Leveling asymmetrical profiles indicate construction in most instances; these profiles are not common on prehistoric roads. Gullied asymetrical profiles usually occur on the downslope side of roads where the road does not parallel the hillslope, and locally on other roads as a result of slight meandering of the gully within the roadway.

Positive Topographic Expression. These are profiles in which the present road surface is higher than adjacent land surfaces on either one or both sides (Figure 6-11); by definition, profiles of this division are indicative of construction. They are not abundant on Chacoan roads.

Roads having a positive topographic expression are divided on the same basis as, and similarly to, roads having negative expression. Two classes are recognized, low and high. Low profiles are those in which the road has less than 35 cm relief above the surrounding terrain, whereas high profiles have more than 35 cm relief. This distinction is purely arbitrary, and it should be realized that positive-expression roads will be subjected to increased erosional processes because of their greater relief. Consequently, it is possible that roads now classed as "low" might have been classed as "high" while in their primary condition. Positive-expression profiles are common on modern machinery-maintained roads, but uncommon on Chacoan roads.

Two symmetry categories are recognized, symmetrical and asymmetrical (Figure 6-11). Symmetrical profiles are expected in the absence of effective erosion of the roadbed. Asymmetrical profiles are indicative of leveling construction in most instances. Neither of these categories is common on prehistoric roads (see discussion of fill longitudinal profile, this chapter).

Two types of positive-expression profiles are recognized, parabolic and angular. Parabolic profiles are to be expected in most positive-expression prehistoric roads in the absence of masonry border elements. Angular profiles without border elements have not been recognized and their existence is thought to be unlikely; however, angular profiles are common on machinery-maintained historic roads.

Positive-Negative Topographic Expression. In these profiles a portion of the road projects above adjacent terrain, and a part is below adjacent terrain (Figure 6-8). Usually found on the sides of hills, this profile is common on historic roads and is only rarely present on prehistoric roads. It is always indicative of construction for the purpose of leveling the roadbed.

Border Elements. Border elements (Figure 6-12) are so named because of their position at the border, or margin, of roads. They are products of construction or maintenance and are recognizable cultural features which are in Direct Association with roads (see Chapter 9).

BORDER ELEMENTS

1. Absent/not recognizable (100)
2. Positive topographic expression (200)
    1. Walls (210)
        1. Masonry (211)
        2. Cobble (212)
        3. Adobe (213)
        4. Adobe-stone (214)
    2. Curbs (220)
        1. Masonry (221)
        2. Cobble (222)
        3. Adobe (223)
        4. Adobe-stone (224)
    3. Cairns (230)
    4. Mounds (240)
        1. Earthen (241)
        2. Rubble (242)
    5. Berms (250)
    6. Stone concentrations (260)
    7. Isolated stones (270)
    8. Wooden posts, curbs or walls (280)
3. Negative topographic expression (300)

Figure 6-12. Proposed classification of border elements.

Border elements are often relatively diminutive in relation to the roadway itself, and are commonly in raised positions or on artificially steepened slopes, which concentrate the intensity of weathering and erosional forces acting to destroy these features. In some situations, the border elements may be so eroded or buried that their presence may not be detectable by ground observation. For this reason it is difficult to devise a comprehensive, tightly defined classification of border elements based only on the characteristics visible at the present surface. It is likely that secondary processes have modified or obscured the original elements and that excavated profiles would indicate re-classification of these features in some instances.

Classification of border elements will require judgement on the part of the field archaeologist in many instances. Surface characteristics are often the only information available, and the aforementioned secondary processes sometimes make classification tentative at best. Despite this, surface observations may provide preliminary information useful in the interpretation of road morphology, and can be used to direct future detailed examinations.

An important consideration in the classification of border elements is their extreme variability. Not only are they highly variable in visibility because of secondary processes, but primary characteristics are also variable. Border elements are seldom continuous for more than a few tens of meters. In addition, they may be present on one side of a road, usually the downhill side, but not on the other. To complicate the problem of recognition and classification even further, one side of a road may possess one type of border element, whereas the other side may have a different type. Because of these factors, border element descriptions are only valid for specific locations within a road segment. Any given segment, whether a visible swale or photo-visible segment, may have two, three or more types of border elements. This tendency for variability to be highly localized is typical of many road characteristics.

In the proposed classification, border elements are divided on the basis of presence/absence, topographic expression, shape, and component composition. Three first-order divisions are recognized on the basis of presence/absence and topographic expression: 1) absent/not recognizable, 2) positive topographic expression, and 3) negative topographic expression. Of the three divisions, only positive features are further subdivided into classes.

Absent/Not Recognizable. The majority of the identified Anasazi road segments do not possess recognizable border elements. Placement of the border of a given road segment into this division is not a conclusive statement that border elements do

not or did not exist, merely that none are recognizable from the surface at the present time. In several instances where border elements have been examined, for example near Pueblo Alto, no indication of border elements was present at the surface, but subsequent excavation revealed their presence.

Positive Topographic Expression. As the name implies, border elements having positive topographic expression stand in relief above the adjacent terrain and road. The amount of topographic relief is highly variable, ranging from a few centimeters to a meter or more in some instances. One report (Holsinger 1901) refers to a road near Pueblo Bonito which was walled to a height of 20 feet, but border elements of this magnitude are extremely rare, if they exist at all. Many border elements, e.g., stone concentrations, may have originally possessed considerably more relief than is visible at the present time, but have been reduced by secondary processes to the point of being barely detectable.

The presence of positive-expression border elements is by definition evidence of road construction, and in many instances may be the only conclusive indication that construction has taken place. It has been previously reported that border elements tend to be found only in the proximity of sites or where the road crosses bedrock or bedrock with a thin soil mantle (Ware and Gumerman 1977, Hayes 1981). If taken literally, this might be interpreted to indicate that excavation (construction) occurred only in these localities. It is true that most border elements are found in the above-mentioned locations. This does not mean, however, that construction only occurred in these locations, but rather that materials amenable to recognizable preservation tend to occur in these locations.

Border elements are commonly recognizable in areas of thin soil overlying sandstone bedrock as a concentration of rubble removed from the bedrock. Most secondary processes operating to destroy the border elements do not readily remove the larger rubble fragments, rather, selectively remove sand-size and smaller sedimentary particles. Thus, a border element composed only of soil materials could be completely obliterated, whereas one containing rubble would still be recognizable. Trench 12 clearly indicates that the absence of a visible swale cannot necessarily be construed as indicating the absence of construction.

Eight classes of the positive topographic expression division have been recognized as theoretically possible, based on the shape and articulation of the border elements and their components. At least one of the classes, wooden posts, curbs or walls, has not been recognized on Chacoan roads, nor is it thought likely to be because of preservation problems, but it is included here because of the theoretical possibility of its former presence.

WALLS. Walls are often present as border elements near major sites and in topographically impeded areas such as cliff faces (Ware and Gumerman 1977, Hayes 1981, Appendix A this report). A wall is here defined as a masonry, cobble, adobe or adobe-stone feature which: 1) if masonry or cobble, had a primary height of three or more courses of stones, or a primary height in excess of 25 cm; 2) if adobe or adobe-stone, had a primary height of 25 cm or greater; 3) if masonry, was compound or core-and-veneer; 4) had a width in excess of 50 cm; 5) was or was not parallel to the axis of the road.

Masonry walls are by far the most commonly recognized, and have been widely reported in the Chaco Canyon area. Cobble walls have not been identified on Chacoan roads and cobbles were not a favored building material of the Chacoans. Theoretically, however, they could exist, especially in the San Juan River Valley where cobbles are abundant. The presence of cobble walls would probably indicate Mesa Verdean construction, however it is highly unlikely that Mesa Verdeans would make the effort to improve Chacoan roads.

Adobe walls on Chacoan roads have not been examined, but Vivian (Appendix A) does report an instance of an adobe or adobe-stone wall revealed in excavations near Pueblo Alto. In addition, Loose (1974) indicates that an adobe-stone wall was found in one trench near Penasco Blanco. Adobe-stone walls must be approximately 50 percent or more adobe to be classed in this category.

CURBS. For this report, the definition of the term curb has been changed somewhat from previous usage. Recent investigators have utilized the term "curb" or "curbing" to refer to any more or less continuous ridge of material at the margins of the road. This ridge could apparently have been of masonry, rubble, or rubble and earthen materials (Ware and Gumerman 1977, Appendix A this report). As a possible means of avoiding potential confusion between curbs, curbing and walls, the term curb is here re-defined to include low, narrow, linear features of stone or adobe, or a combination of the two (Figure 6-13). Curbs should be: 1) less than two courses or 25 cm in primary height, if composed of stone; 2) less than 25 cm in primary height, if composed of adobe or adobe-stone; 3) less than 50 cm in width, regardless of composition; 4) parallel to the linear axis of the road; and 5) of other than core-and-veneer masonry.

In many cases, without excavation, there will be problems differentiating between walls and curbs. Any feature not paralleling the road is arbitrarily classed as a wall, as is any compound core-and-veneer feature. If the feature parallels the road, but height, masonry style or other characteristics cannot

Figure 6-13. Masonry curbing exposed in the Pueblo Alto area during excavations by Vivian and Buettner in 1971.

be determined without excavation (and excavation is not possible), then the feature should be arbitrarily classed as a curb for the sake of consistency.

CAIRNS. Cairns are abundant in the Chaco Canyon region, and are often found along roads, especially near Canyon margins. Hayes (1981) reports at least 20 cairns in "association" with roads or stairs. Most of the cairns investigated or previously described are low, circular piles of stone, seldom exceeding a meter in height or diameter. Most cairns are probably the result of historic Navajo or other activities rather than Anasazi (Hayes 1981, see also Chapter 9). In some instances where cairns are in apparent association with steps or roads, they may represent the results of Navajo reutilization of Anasazi roads. According to Stein (Chapter 9), Bonito Style cairns are generally larger than 1 m in diameter (Figure 9-11). The presence of Bonito Style cairns in association with roads is not common, despite the fact that the roads are thought to be largely a Bonito Phase manifestation.

MOUNDS. Mounds have been described as border elements near Pueblo Alto by Ware and Gumerman (1977), on the North Road by Irwin-Williams (1973b), and near Kin Ya'a by Vivian (Appendix A), among others. In this report the term mound will be restricted to discrete, isolated, more or less circular or amorphous hummocks of earthen or rubble materials in Direct Association with the road (see Chapter 9). Low, somewhat irregular but continuous ridges of these materials paralleling the road will be classed as berms (see below). One of the best examples of a mound as here defined may be seen on the Penasco Blanco to Ahshislepah Road near Vivian and Buettner's trench (LA 34308) (Vivian and Buettner 1971).

BERMS. Berms are here defined as broad, low, linear ridges of earthen or rubble materials paralleling the road at the margins. Berms are generally thought to represent more-or-less unconsolidated material which has been excavated, scraped or cleaned from the roadway and piled adjacent to it. They may be more than several meters in definable width, but very seldom exceed 15 cm in height above the extra-road terrain. Berms, as with many of the other border elements, are commonly more abundant or larger on the downslope side of the road. They are one of the most common types of border elements, especially in areas away from major sites or Chaco Canyon. Excellent examples of berms may be seen on the Pueblo Pintado to Chaco Canyon Road for several hundred meters west of Pueblo Pintado.

STONE CONCENTRATIONS. Stone concentrations are found in many areas as border elements of Chacoan roads. Stone concentrations are defined as areas of increased frequency of stones along the margins of roads, usually without significant relief. There are two probable origins of these concentrations: 1) "casual" cleaning of occasional stones from the roadway surface, without any significant removal of earthen materials; and 2) reduction of a former berm composed of earth and rubble by secondary processes effective enough to remove all but the coarser detritus. In many instances, the concentration of stones along the margin is not readily visible to the naked eye, but can be detected by stone counts (see below).

ISOLATED STONES. Isolated stones are found in road-marginal positions in numerous locations throughout the Chacoan road network. These stones vary in size from cobbles to boulders and occur in situations where they could not have been deposited by natural processes. They may have been brought to their present locations to serve the function of delineation or survey markers (see discussion of engineering below).

WOODEN POSTS, CURBS OR WALLS. Wooden posts, curbs, or walls, as previously mentioned, have not been found in association with Chacoan roads, but are included here because of their theoretical possibility. The likelihood of their preservation is considered nil, if, in fact, they ever existed.

Negative Topographic Expression. Border elements are lower than the adjacent terrain or roadway in this class. The only report of negative border elements known to this writer is from Irwin-Williams (1973b). It is thought unlikely that negative border elements will be found along Anasazi roads. However, modern roads, particularly those that are machinery maintained, commonly have

negative border elements. The presence of these negative features should therefore be an indication that extra scrutiny of the road is warranted to ensure against the mis-identification of an historic road as prehistoric.

Character of Roadbed. The character of the roadbed is yet another measure of the formalization of a road system. Prepared roadbeds are indicated when deliberate modification of the natural surface can be recognized. By definition, this would include all constructed road segments except those in which border element materials are brought from some other area, such as, perhaps, masonry walls. Prepared roadbeds have been separated into six first-order divisions: a) cleared of stones; 2) excavated roadbed, no other preparation; 3) excavated roadbed, surfaced; 4) raised roadbed, no other preparation; 5) raised roadbed, surfaced; and 6) no topographic modification except for surfacing. Several of these divisions have not been observed on Chacoan roads and are included here only because of the theoretical possibility of their existence.

Cleared of Stones. This division is defined to include those situations in which loose stones have been removed from the roadbed, without the removal of significant quantities of soil or sediment matrix. In practice, simple clearing of stones from the roadbed may not always be recognizable because of erosion of the roadbed during or following utilization, or removal of stones as a function of maintenance during utilization. Another potential recognition problem is that shallowly excavated roadbeds may be filled subsequent to use by secondary depositional processes and may then present the same physical appearance as roadbeds cleared of stones. Because of these recognition problems, field identification of roadbeds "cleared of stones" shall be confined to those road segments where no visible swale is present, but where there is an increase in stones, without topographic expression, along the margins of the road.

Excavated Roadbeds. Excavated roadbeds indicate a greater degree of preparation than simple clearing of stones, in that excavation indicates removal of appreciable quantities of soil or sediments, which, in the absence of mechanized equipment, implies a significant increase in labor investment. Two divisions of excavated roadbeds are theoretically possible, based on the presence/absence of application of any surfacing material subsequent to excavation.

EXCAVATED ROADBED, NO OTHER PREPARATION. As the name indicates, this division is characterized by a lack of surfacing material applied to the roadbed following excavation. Two classes are recognized within this division.

EXAVATION TO A COMPACT SUBSURFACE HORIZON. This class may be difficult to recognize from surface observation because secondary processes of erosion often remove material selectively from the roadbeds. Although this is usually obvious in the case of removal by runoff, removal by deflation is sometimes more difficult to recognize. As a means of compensating for this difficulty of recognition, a conservative definition has been adopted. A road shall be considered excavated to a compact subsurface horizon only if a visible swale and/or a recognizable berm, mound, or concentration of stones is present at the margins of the roadbed depression. Although this definition may exclude some segments which have been excavated, it also excludes the much more likely situation of secondary deepening of the road by erosion. Most instances of roadbed preparation recognized on Chacoan roads are of this type. The function of excavation to a compact subsurface horizon is not known at the present time, although it may have been done to facilitate travel on the roads, or perhaps as a means of delineation.

EXCAVATION INTO BEDROCK. Under ordinary circumstances, this class will be recognized from surface observation only if the bedrock is exposed at the surface, or if a very thin mantle of sediments overlies sandstone bedrock. Excavation into bedrock may be indicated by a marked concentration of sandstone at the road margins, however. Roadbeds should be placed in this category only if significant excavation has occurred, not if an occasional sandstone spall has been loosened and removed from the roadbed. Minor pecking into the sandstone would probably not be recognizable unless the roadbed is exposed at the surface. Excavation to (not into) bedrock would be classed as excavation to a compact subsurface horizon.

The most common examples of excavation into bedrock are stone-cut steps (Figure A-7). Hayes (1981:48) indicates that steps of this type have been noted at 45 locations in the Chaco Canyon area. Loose (1974) also described a trench profile near Penasco Blanco in which the road had been incised into sandstone bedrock. Excavation into bedrock is not a commonly recognized type of roadbed preparation on Chacoan roads, except in specialized situations. Very steep sandstone areas often have some form of excavation into the bedrock, and there is commonly excavation to or into bedrock in the immediate vicinity of Herraduras (see Chapter 9). All other lesser excavations into bedrock have been arbitrarily excluded, mainly because of the scale of excavation. Thus hand-and-toe holds are excluded, as are linear grooves such as those described by Vivian (Appendix A) between Pueblo Alto and Pueblo Bonito, and south of Kin Ya'a.

Roadcuts into sandstone bedrock were found in several locations where the excavation served no apparent function for reducing the grade of the road, providing easier access, or otherwise facilitating travel on the road. It is thought that these cuts may have served the purpose of delineating the road. An example of this type of cut may be seen on the South Road in Section 27, T. 20 N., R. 11 W.

EXCAVATED ROADBED, SURFACED. Excavated road segments could theoretically have additional modification of the roadbed in addition to the excavation. Although suggestions of surfacing of the roadbeds are tantalizing, documentation remains elusive, except in limited locations. Navajo reports (Gladwin 1928) of a "clay road" which extended from the Skunk Springs area suggest surfacing, but remain to be documented. Although only limited instances of surfacing have been recognized on prehistoric roads in the Chaco Canyon area, it is possible that more may have existed, and for this reason the following surfacing categories are listed as potentially occurring: 1) caliche, 2) adobe, 3) cobbles, 4) flagstones, and 5) wood or other organic materials.

CALICHE SURFACING. This type of roadbed preparation includes only those situations in which caliche from some other locality was emplaced as road surfacing material. Those situations in which excavation of the roadway penetrated to a natural caliche horizon (Ware and Gumerman 1977) would be classed as excavation to a compact subsurface horizon. Roadbed preparation of this type has not been recognized on Anasazi roads.

ADOBE SURFACING. Gladwin (1928) cites Navajo reports of a "clay road" built between the Skunk Springs area and Pueblo Bonito which suggests a possible adobe surfacing, although this has not been confirmed. Surface and subsurface examinations of other roads have yet to result in the recognition of adobe surfacing on any road. Vivian (Appendix A) reports that trenching in the vicinity of Pueblo Alto revealed adobe in association with roads, but not apparently as road surfacing material. It is unlikely that either intentional or unintentional adobe preparation would be either preserved or recognizable from surface observations; however, excavations subsequent to surface observations may result in the re-evaluation of this classification.

COBBLE SURFACING. This category is here defined as a more or less continuous surfacing of non-tabular stones, which may be of other than the strict cobble size defined by the Wentworth Scale (Table 6-2). This type of roadbed preparation is common on historic roads in some areas of the world, but has yet to be recognized on Anasazi roads.

FLAGSTONE SURFACING. This category includes those situations in which flaggy sandstone was laid down to form a continuous or semi-continuous "pavement" lining the roadway. At least four instances of "flagstone paving" have been reported in the literature, the "Avenida Kin Bineola" (Marshall et al. 1979), near Pueblo Alto (Lyons and Hitchcock 1977), near Casa Chiquita (see Appendix A, Table A-4), and on the Penasco Blanco to Ahshislepah Road (Hayes 1981). Two of these instances occur on raised features whose relationship to roads is incompletely understood. Neither the "Avenida Kin Bineola" nor the Pueblo Alto "causeway" fit most characteristics of other roads in the Chacoan system. The "paved" portion of the "Avenida Kin Bineola" cannot be a canal per se (see Appendix A), but it is totally uncharacteristic of any other road in the Chacoan network. The Casa Chiquita "paving" is sporadic, discontinuous, and of very limited extent, and, although several visits were made during this project to the Penasco Blanco to Ahshislepah Road locale described by (Hayes 1981), the described paving was not recognized. Therefore, paving is not thought to be a common characteristic of Chacoan roads, although it does apparently exist in some incompletely understood situations.

TABLE 6-2

TABLE PORTION OF THE WENTWORTH SCALE USED IN ROCK COUNTS

Particle Class	Size Range (mm)
Medium boulders	1024-512
Small boulders	512-256
Large cobbles	256-128
Small cobbles	128-64
Very coarse pebbles	64-32
Coarse pebbles	32-16
Medium pebbles	16-8
Fine pebbles	8-4

WOOD OR OTHER ORGANIC SURFACING. Lining roads with logs to form "corduroy" roads was a common practice in some wet areas for the construction of historic roads, as was the practice of lining dry, sandy roadbeds with wood and brush. Neither of these types of roadbed preparation has been, nor is likely to be, recognized on Anasazi roads, because preservation of wood in the roadbed environment is highly unlikely.

Raised Roadbed, No Other Preparation. Although raised roadbeds are not common, most known examples are characterized by a lack of other roadbed preparation (see discussion of causeways, this chapter).

Raised Roadbed, Surfaced. With the possible exceptions of the previously described "Avenida Kin Bineola" and Pueblo Alto "causeway", no surfaced causeways have

been observed in this investigation or described by previous investigators.

No Topographic Modification Except for Surfacing. No instances of this type of roadbed preparation were observed in this investigation.

Engineering and Construction

One problem which has hindered roads research is the fact that the terms "engineering" and "construction" have not been defined as they pertain to Chacoan roads. Ebert (1973:6), for example, seems to indicate that construction and engineering are synonymous: "Evidence of formal construction--in the sense of anything being added or altered--is rare over the vast bulk of the roadway segments yet discovered....It is conceivable that hundreds of miles of such roadway were so 'unengineered' as to be totally lost to any recovery technique today." Lyons and Hitchcock use the terms similarly in their statement "that features observed in numerous localities on the ground and on photographs indicate their extensively engineered characteristics....Untold numbers of cubic yards of topsoil were scraped from the surface and mounded along the roadways" (1977:125). Hayes was among the first to imply that there was some distinction between the two terms: "Although the engineering required to lay out the roads was relatively sophisticated, construction was simple" (1981:47).

There has been some question as to the degree of "engineering" and/or "construction" performed in the development of the Anasazi roads. Ebert (1973:6) felt that the roads were primarily "the result of use more than organized construction" and Lyons felt that the roads had developed "more from use than having been engineered" (1973:12). Later, however, Lyons and Hitchcock stated that "the roadways are well-engineered features, which required extensive construction and maintenance" (1977:130). Flynn (1981:15) apparently felt that "roads and trails in the San Juan Basin are the consequences of simple use or casual or expedient construction." Ebert and Hitchcock (1980:188) suggest a low level of engineering: "It would appear that the Chaco road system was not formally engineered--in the sense of anything being 'constructed' or 'built'--in its entirety but was instead the result of 'navigational' routes that facilitated foot travel between points of population aggregation. These routes in some cases run in the direction of topographic landmarks that were known by the inhabitants of Chaco to lie near desired locations. This might account for the surprising linearity of the roadways through the region's uneven terrain." The straight nature of the other prehistoric roads, however, was cited by Lyons and Hitchcock (1977:128) as being indicative of engineering: "The engineered nature of the pathway is suggested by the description 'in perfectly straight lines.'"

The apparent confusion between the terms engineering and construction extends beyond those investigating prehistoric roads. The most applicable dictionary definition of engineering found is "planning, designing, construction or management of machinery, roads, bridges, buildings, fortifications, waterways, etc." (Guralnik and Friend 1964). Numerous other definitions were found, but the common theme involves planning and design. The word construction likewise has many connotations, but the meaning seemingly most applicable to Chacoan roads is "to pile up, arrange, build" (Gove 1976). It is apparent that there is a fine line of distinction between "design," "arrange," and "build." In order to eliminate, insofar as possible, the problem of confusion between the terms "engineering" and "construction" as they apply to prehistoric roads, the following definitions are suggested.

Engineering is here defined as the conception and planning of a route of travel to a known destination, involving survey and demarcation of that route prior to or during construction. Construction is here defined as any intentional modification of the land surface for the purposes of developing a land route of travel, involving removal, addition, or rearrangement of earth or plant materials. Thus excavation of a roadway, placing the excavated material in a road-marginal position, or building a masonry wall would all be within the definition of construction, whereas the gradual deepening of a roadway through attrition, deflation or other forms of erosion would not. (There is no implication of purpose of construction intended.)

Engineering

There is much evidence to suggest that Chacoan roads were extensively engineered. This evidence includes the unusual width, consistency of road characteristics over widely separated areas, relationship of the roads to the terrain, characteristics of the road course, and the possible remains of a surveying and/or delineation system.

The consistent and unusual width of the roads is interpreted as being indicative of a preconstruction survey of the road course. Width appears to be relatively constant on roads regardless of their location within the road network although roads are consistently reduced in width in specific topographic positions. The unusual width is puzzling, as it is far wider than would be required for normal foot traffic, and its consistency indicates the width was purposefully planned and probably defined throughout the road network for those involved in or utilizing the roads.

It has been frequently reported that Chacoan roads are straight (Lyons 1973, Lyons and Hitchcock 1977, Ware and Gumerman 1977, Obenauf 1980a, Hayes 1981). A lone voice of

dissent to this consensus of opinion is that of Flynn (1981), who stated that the presumed Chacoan roads were nearly identical to Navajo wagon roads (which are usually anything but straight), and cited remarks that a wagon should be able to traverse trails passable to foot and horse traffic (Schmedding 1951). The "surprising linearity" (Ebert and Hitchcock 1980:188) and "frequent and somewhat puzzling disregard of topographic obstacles" (Lyons and Hitchcock 1977:125) are unlike historic formal and informal roads, which tend to curve around obstacles for the purpose of reducing slope grade. In comparison with modern engineered roads, the Chacoan roads seem inefficient and appear to some not to be formally engineered (Ebert and Hitchcock 1980). Others apparently consider the "incredible linearity" (Lyons 1973:12) as an indication that the Chacoan roads are well-engineered features (Lyons and Hitchcock 1977).

Detailed measurement of road segments for this project revealed that the reportedly straight roads actually consist of a series of approximately aligned straight segments, which together often produce a straight trend for a larger portion of the road. Any individual segment may deviate slightly from the trend. These deviations are hypothesized to represent adjustments to maintain the desired course. Minor course adjustments appear to have been accomplished by means of slight angle changes usually occurring either at higher topographic positions such as ridge tops or in drainage bottoms. It is usually not possible to see the actual angle change on the ground.

Major course adjustments are usually in the form of an abrupt angle change (dogleg), and appear to occur only at sites, at the confluence of two or more roads, or at prominent topographic breaks. Chacoan roads supposedly have no curves. "There are no sweeping curves or lazy bends in the Anasazi roads" (Hayes 1981:46). However, previous reports to the contrary, broad sweeping curves are not unknown on Anasazi roads. Examination of low sun angle photographs and other aerial photography showed broad sweeping curves to be present in the southern one-third of the Penasco Blanco to Ahshislepah Road (Figure 4-6), and the road extending from above Hungo Pavi to the small mesa in the Chaco North area (Figure 4-13). These curves do not necessarily conform to topography. Sinuous curves also occur on prehistoric roads, but only very locally, in the immediate vicinity of particularly steep topographic obstacles such as canyon walls and rims. The roads do not normally deviate in direction for minor local topographic features such as hills, mesas or canyons unless that feature presents a significant barrier to travel. Most minor topographic barriers are overcome by means of terrain modification such as steps, ramps, or roadcuts. Major topographic barriers are thought to be avoided where possible, a characteristic interpreted by some to be evidence of engineering or pre-planning. Several known roads project into major passes in the Dutton Plateau, a barrier to travel at the southern margin of the San Juan Basin.

As one possible means of comparing the "efficiency" of Chacoan roads to modern roads, a study was made of the prehistoric North Road and the modern Blanco Trading Post-Chaco Canyon road. To obtain maximum comparability, only those portions of the two roads shown on the Pueblo Bonito 7.5' topographic quadrangle were compared. The North Road was measured from the southern boundary of the quadrangle (Section 24, T. 22 N., R. 11 W.) to the northern margin of the map (Section 1, T. 23 N., R. 11 W.). The modern Chaco Canyon-Blanco Trading Post road was measured from the southern boundary of the map in Section 19, T. 22 N., R. 10 E., to the northern boundary of the quadrangle in the Section 10, T. 23 N., R. 10 W. The comparison of the two roads is not completely valid, as the roads are not exactly parallel, but both have the same generally north-south trend, and both trend roughly perpendicular to the topographic grain. No more closely comparable historic and prehistoric roads of any length could be found for this analysis. Results of the comparison are shown on Table 6-3. Somewhat surprisingly, the North Road, despite going straight over obstacles, appears to be the more "efficient" of the two roads, having less total elevation change and a shorter distance between endpoints.

The argument has been advanced that the Anasazi simply sighted on some distant or intermediate landmark and walked straight toward that feature, thus forming the "navigational route" of Ebert and Hitchcock (1980). However, it should be noted that the roads deviate from trend only slightly, even when the distant horizon landmark is hidden by an intervening topographic feature. Most archaeological surveyors or fence builders will attest to the virtual impossibility of walking an absolutely straight line with only a single distant landmark as a point of reference. Unless some combination of three landmarks and/or people were involved, or a system of aligned markers to provide multiple points of reference, there is no logical explanation for the straightness in alignment of individual road segments. A multiple-person or "marker" system of surveying could also explain the fact that minor course changes often occur at ridge tops, where realignment on the distant landmark or backsighting could have taken place.

Ground surveys of the road corridors revealed the occasional presence of cobbles and small boulders along the margins of the prehistoric roads (see Isolated Stones, above). These stones, usually sandstone, have a wide variety of sizes and shapes. They are found in areas where sandstone does not outcrop in the immediate vicinity, in dune sand and in other locales where they could not have arrived at their present position by natural

TABLE 6-3

COMPARISON OF CHARACTERISTICS OF THE MODERN BLANCO TRADING POST-CHACO CANYON ROAD AND PREHISTORIC NORTH ROAD. MEASUREMENTS CALCULATED FROM THE PUEBLO BONITO NW 7.5' TOPOGRAPHIC QUADRANGLE

Road Statistic	Modern Road	Prehistoric Road
Average trend of road on quadrangle	N 01° E	N 26° E
Total length of visible or projected roadway within quadrangle	17.42 km	13.5 km
Total length of imaged segments[a/]		6.8 km
Total length of projected segments		6.7 km
Average length of imaged segment		.52 km
Average length of projected segment		.55 km
Straight-line distance from beginning to end of road on quadrangle	14.89 km	13.3 km
Difference between straight-line distance and visible or projected length	2.53 km (85.4% efficiency)	.2 km (98.5% efficiency)
Elevation at southern boundary of quadrangle	6,240 ft.	6,240 ft.
Elevation at northern boundary of quadrangle	6,700 ft.	6,480 ft.
Total change in elevation along road from southern to northern boundaries of quadrangle[b/]	5,500 ft.	2,500 ft.
Average change in elevation (total visible or projected length)	316 ft/km	185.2 ft/km
Average change in elevation, imaged segments		182.3 ft/km
Average change in elevation, projected segments		188 ft/km
Total curvature, measured or projected length	523.5°	189°
Total curvature, imaged segments		22°
Total curvature, projected segments		167°
Average curvature, total visible or projected length within the quadrangle	30.05°/km	14.0°/km
Average curvature, imaged segments		3.2°/km
Average curvature, projected segments		24.9°/km

a/ Photointerpretation by Margaret S. Obenauf, Bureau of Land Management.
b/ Determined by counting the number of contour lines crossed by the road.

means of colluviation or alluviation. No stones of "exotic" origin such as San Juan River quartzite cobbles were located. The stones do not appear to have a regular spacing or to occur in consistent topographic positions. These stones may be the remnants of a surveying or delineation system used to lay out the road. Individual "marker" stones may have been subsequently buried beneath border elements in some instances by construction, maintenance or secondary processes.

An alternative method of surveying has been postulated to account for the straightness of the roads. This system would utilize a series of fires, essentially functioning as "landmarks" in the surveying system. It would seem that any disadvantages inherent in using natural landmarks as survey points would be compounded by trying to work with fires. The logistical problems of trying to align a series of fires over a distance, in either day or night with no apparent means of long-distance adjustment communication would seem to make this method inefficient and unlikely. In addition, the absence of large burned areas or abundant fire-cracked rock in most expected locations seems to argue against this method of surveying.

Parallel Road Segments

One of the more puzzling characteristics of the Chacoan road network is the existence of parallel road segments in some locations. The North Road, for example, appears to have parallel segments for much of the distance from Halfway House south to the Ahshislepah Wash. In addition, parallel segments have been reported on the South Road near Bee Burrow and also near the Muddy Water community (Marshall et al. 1979), and on the Pueblo Alto system between Pueblo Alto and Pueblo Bonito (Appendix A). Investigations for this project revealed additional parallel segments on the South Road between Casa Patricio and La Mesita de la Junta, and aerial reconnaissance of Haystack Ruin indicated the possibility of parallel road segments extending northwestward from the site. Other tantalizing, but unconfirmed, indications of parallel segments have been seen at several locations on Chacoan roads in addition to the examples cited above.

One of the most intriguing of parallel segments was first identified on BLM 1981 low sun angle aerial photographs taken for this project. In an area from approximately 2 to 4 km north of Pierre's Ruin (Figure 6-14), the North Road appears to consist of not one set of parallel segments, but two. All four segments appear to be almost perfectly parallel to one another in the areas where they are imaged. Segments within each set are spaced less than 15 m apart and the two sets are separated by approximately 30-40 m. These "double parallels" have not been ground verified because, although some segments are clearly visible on the low sun angle photographs, initial reconnaissance efforts to locate them on the ground were fruitless. A few sherds and occasional stones were found, but conclusive verification was not possible using reconnaissance techniques.

At the present time, the function of the parallel segments is not known. A variety of possible explanations could be suggested, including replacement of an older roadway, or different roads for different groups within a society (see Chapter 2). Where parallel segments are present, one of the two segments is typically much less developed than the other. In addition, the less-developed road typically has little, if any, material culture in association, although Morenon (1975) reported ceramic concentrations on both segments of a parallel set near Halfway House. At the present time, however, no conclusive statement can be made as to relative age or functional differences between the segments.

Construction

A possible source of confusion in the discussion of construction of prehistoric roadways is the distinction between maintenance and construction. Maintenance is here defined as the keeping of the road(s) in a certain condition of repair. This may involve the casual or organized cleaning of excess stones, debris, plants, etc. from the roads, or repair of portions of the road surface or border elements damaged by erosion or other means. For all practical purposes, the only distinction between most forms of construction and maintenance is one of timing and intent. Maintenance supplements construction and is intended to maintain, rather than establish, a condition. Although the distinction between construction and maintenance is important to the understanding of labor organization, in practice it is difficult to distinguish between the two by archaeological or geological means, in that both sets of activities usually result in similar end products. Because of this difficulty, it is possible that many of the locations identified as "constructed" road segments may have also been the product of organized maintenance during utilization of the roadway. Unfortunately, no easy solution to the dilemma of field distinction exists, so for the purposes of this report a roadway shall be considered to be constructed if there is evidence of any extensive deliberate modification of the landscape. Thus displacement of an occasional small stone would not be considered to be the results of construction, whereas a pronounced stone concentration, well-defined berms, articulated border elements, or removal of bedrock or earth materials would be classed as evidence of construction.

Examples of prehistoric road construction are numerous and varied in character. Although extensive portions of the roadway may have been constructed, evidence for such activities is most commonly recognized only where bedrock is close to the surface, in the

Figure 6-14. Low sun angle aerial photograph showing multiple parallel road segments north of Pierre's Ruin. Road segments are visible between sets of dots, adjacent to solid line.

vicinity of major topographic changes, and near larger sites (see discussion of border elements in this chapter). Construction in other areas is often difficult to recognize because of the unsuitability of materials for preservation, limited nature of construction in a given area, or secondary modification of the roadway. Although the definition of construction given here includes the removal, addition or rearrangement of plant materials, the only forms of construction observed in this study involved the excavation of earth or stone, transfer of the excavated material to another point (usually in a road-marginal position or at some other location in the roadway), and articulation of materials in masonry walls or stone curbs.

Many researchers have questioned whether the road depression was caused by actual construction or by erosion of the disturbed road surface. The uppermost soil horizon is typically sandy, soft, and loose. Walking on the surface results in the loosening of soil materials and the destruction of vegetation which tends to bind the surface material together. This loosened material would be amenable to removal by deflation or runoff processes. Therefore, the visible roadway depressions have been commonly attributed to secondary processes. However in many instances, where geological conditions are favorable for recognition and preservation, it has been demonstrated that surface materials were intentionally removed and piled adjacent to the road to form a curb or berm (see discussion of trenching program, below). Examination of berm and curb materials in most instances clearly indicates an immediate source for the materials, presumably the roadway itself. Other lines of evidence for construction are discussed in detail in the following sections. Of the various types of road construction heretofore recognized, excavation to a compact substrate has been the most commonly discussed (Ware and Gumerman 1977, Lyons and Hitchcock 1977, Hayes 1981).

Detailed Studies

Rock Counts

Within the study area, unconsolidated material at the surface typically has a large aeolian component in those locations not deflated or locally steepened by erosion. Therefore, most flat or gently sloping surfaces have relatively few stones exposed at the surface. An increase in the number of stones along projected road alignments not attributable to natural mechanisms were evaluated as a possible indication of human activities along the roads.

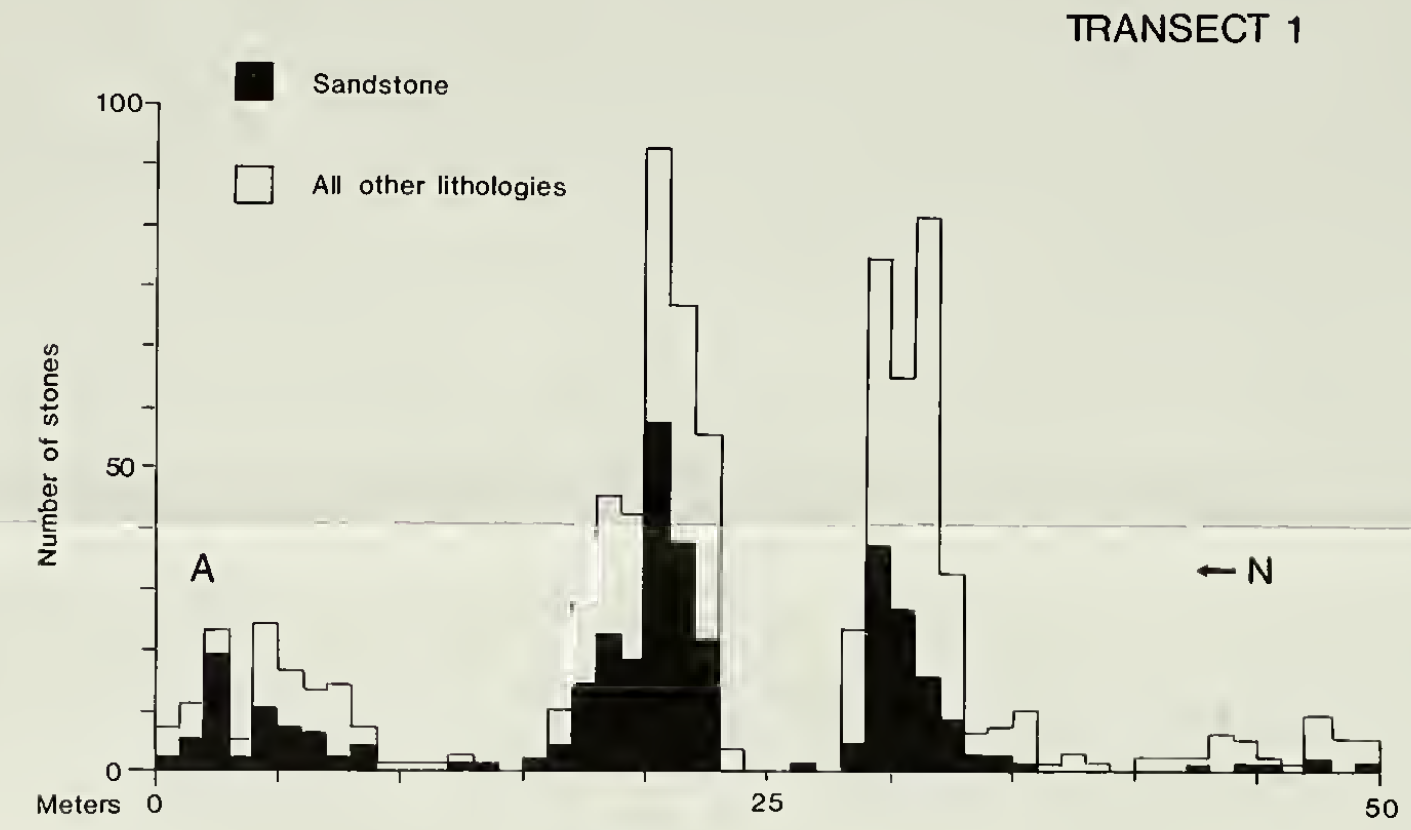
Observations made on ground-visible road segments seemed to indicate that in some geological situations the roads were indeed delineated by a concentration of stones at the margins of the roads, which was often present even where no visible swale could be detected. It was also observed that road-marginal stones often seemed to be characterized by a higher frequency of visible caliche coatings than in nearby, apparently undisturbed areas. Informal tests of these casual observations allowed delineation of projected road segments in several instances, and it was subsequently decided that observations of stone frequency might be a viable mechanism in some instances for delineation of projected, but not visible, road segments and for evaluation of the nature and degree of construction activities. As a means of testing this supposition, a trial documentation procedure was devised in which stones within transects crossing the road alignment were counted and their frequencies plotted as histograms (Figures 6-15, 6-16, 6-17).

Transect locations were initially selected on the basis of differing visibility of road depressions. A transect was selected for each of the following visibility conditions: prominently visible swale (deep symmetrical), moderately visible swale (shallow asymmetrical), and in a projected road alignment where no roadbed depression could be detected. Each of the sample areas was near a trench dug across the road to allow monitoring of subsurface conditions, and each was in an area where subsurface geological materials were suitable for preservation and recognition. Transect locations were on the Pueblo Pintado and Penasco Blanco to Ahshislepah Roads. In each location a transect 50 m long and 1 m in width was measured perpendicular to the road, centered on the visible or projected road alignmment insofar as possible. The transects were divided into 50 sample units of 1 m^2. All stones exposed at the surface above a specified size threshold were counted in each sample unit, and each stone was monitored for size, shape, composition, presence-absence of caliche coatings, and if present, the orientation of the caliche coating. Any sherds present within the transect were counted by sample unit and plotted.

The stones exposed at the surface were sized according to standard Wentworth Scale divisions (Table 6-2). Initially, medium pebbles and all larger sizes were counted. It was soon realized that counting the medium pebble category was extremely time-consuming and therefore this category was discontinued after partially counting Transect 1. Coarse pebbles constituted the lower size threshold for counts in all other transects. Stones larger than small cobbles were encountered in only one transect.

Stones were also monitored for general shape attributes. In the interest of expediency, traditional gravel morphology indices of flatness, roundness and sphericity (Pettijohn 1957) or sand grain morphology classes (Powers 1953, Shepard 1963, Reineck and Singh 1975) were not utilized. Only two shape classes were recognized, "equidimensional" and "tabular." Stones were arbitrarily defined as tabular if the longest axis of the

Figure 6-15 Histograms comparing frequencies of sandstone to all other lithologies in stone counts across a prehistoric road.



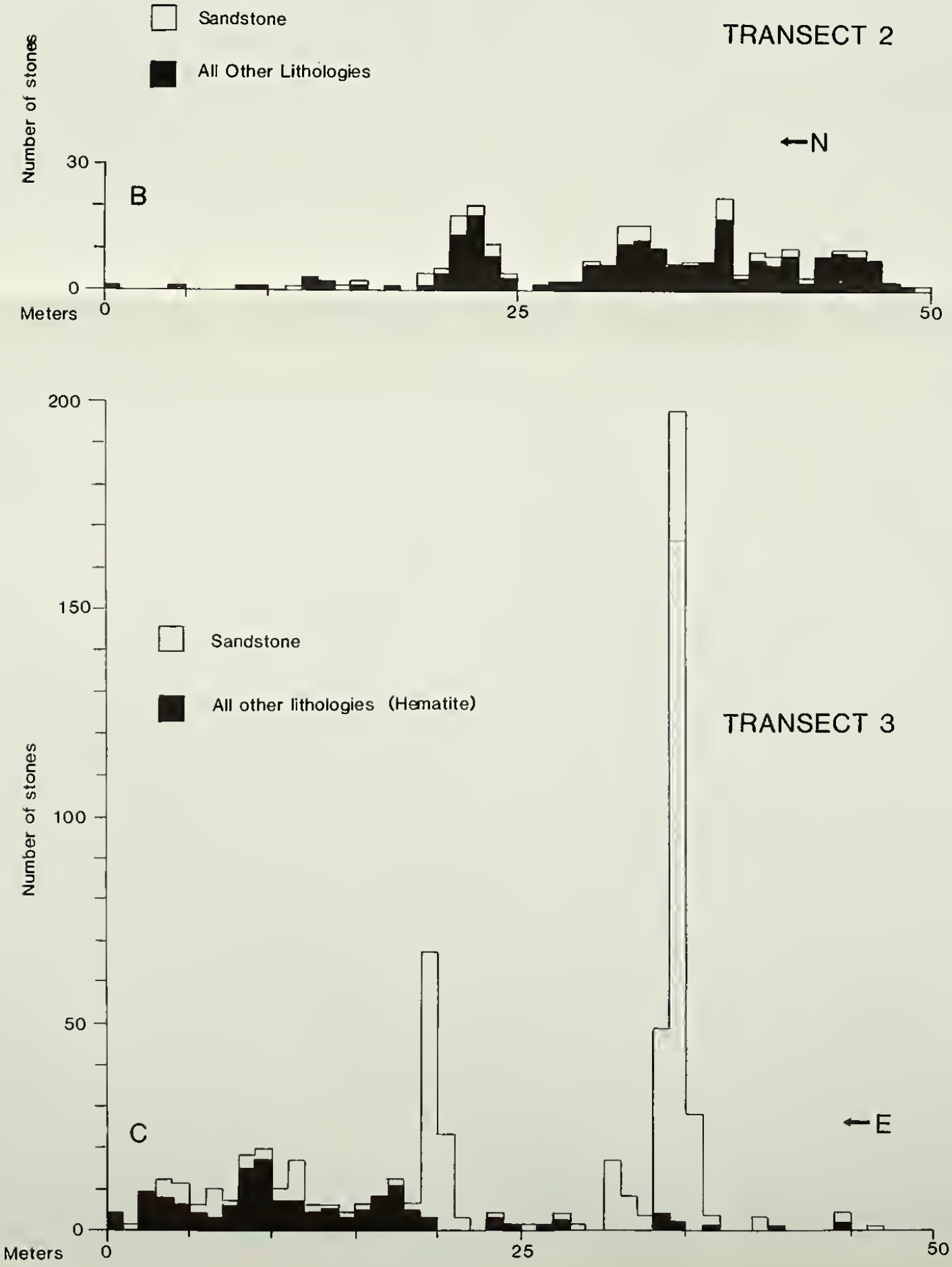
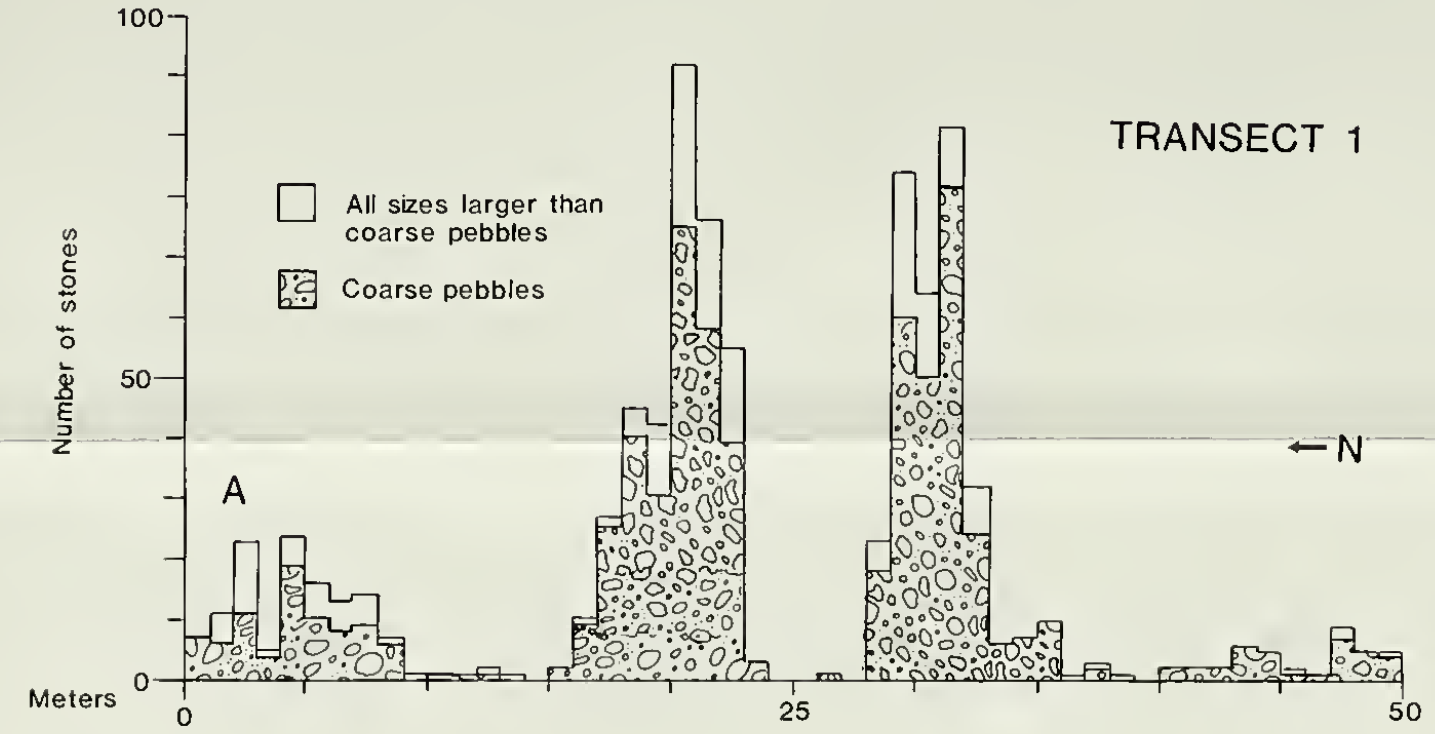
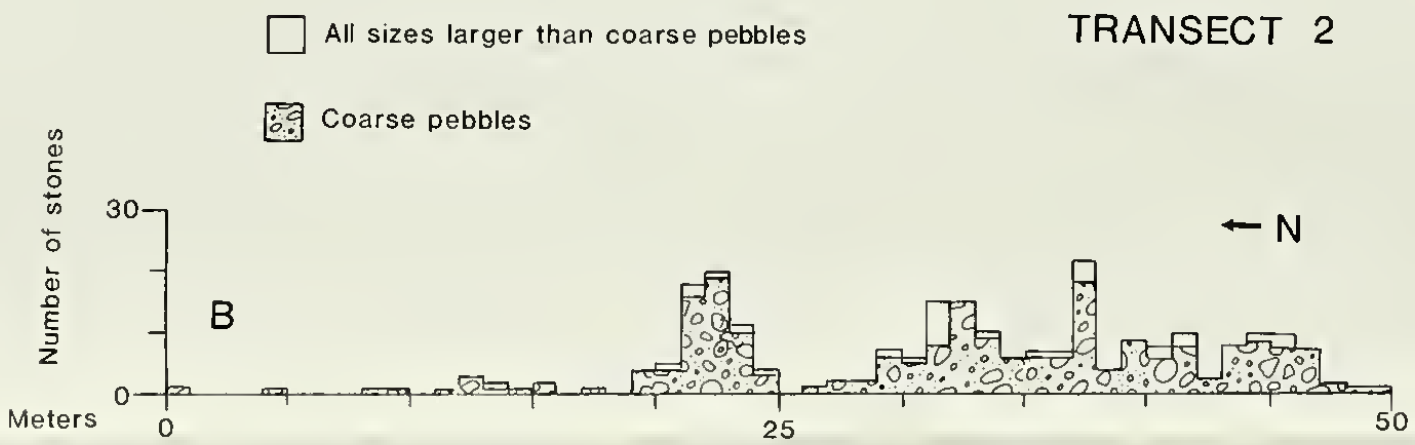


Figure 6- 17. Histograms comparing frequencies of coarse pebbles to all other sizes of stones in stone counts across a prehistoric road.





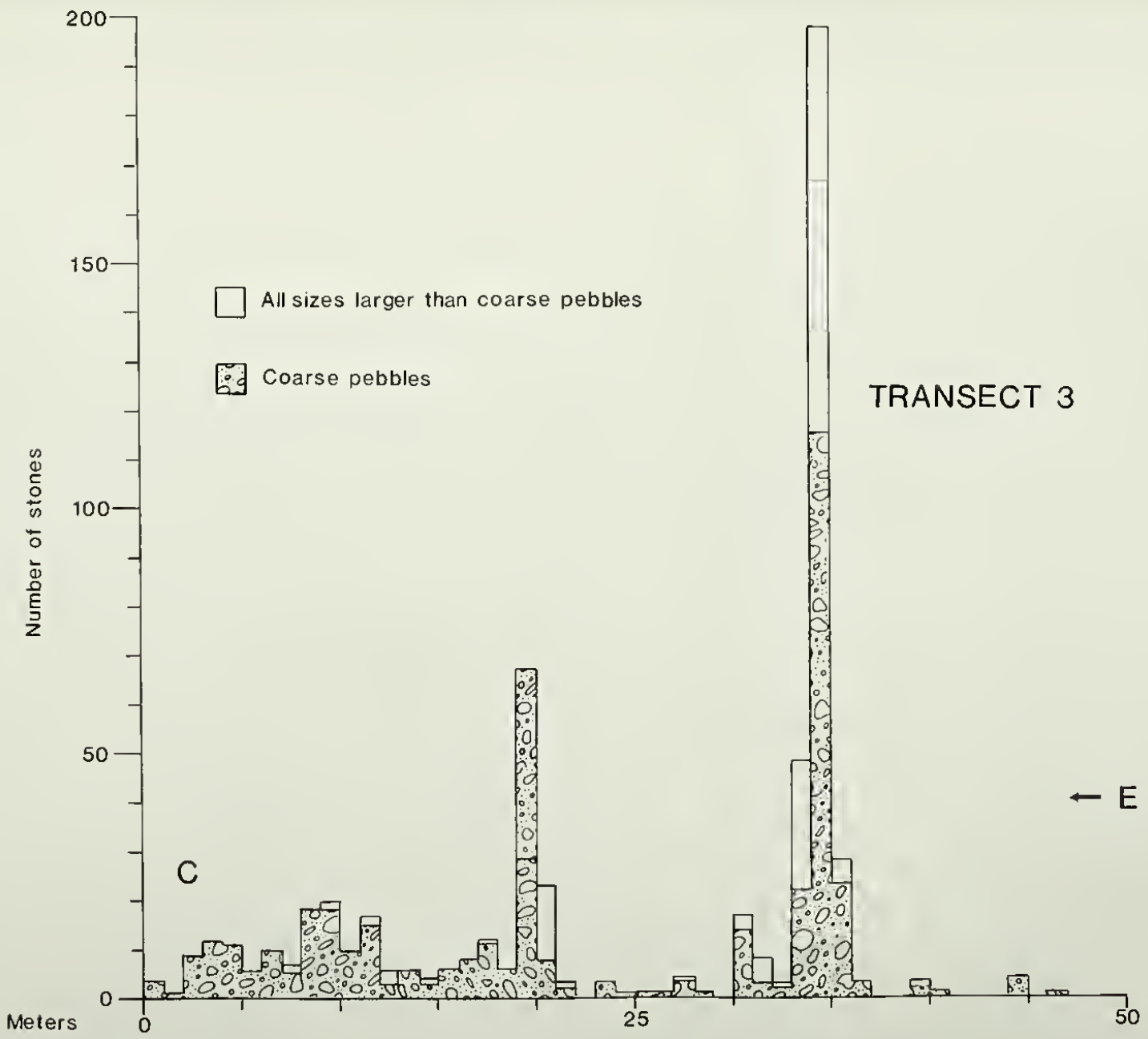
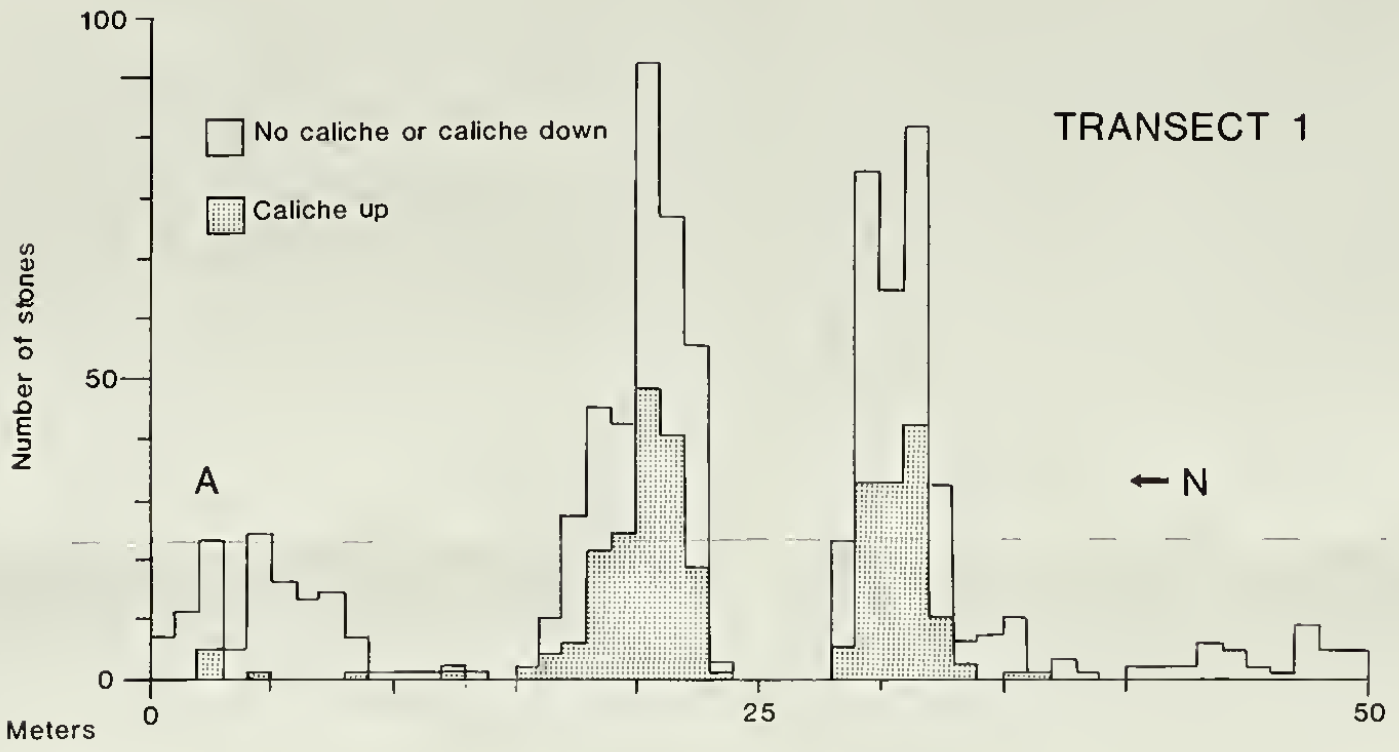
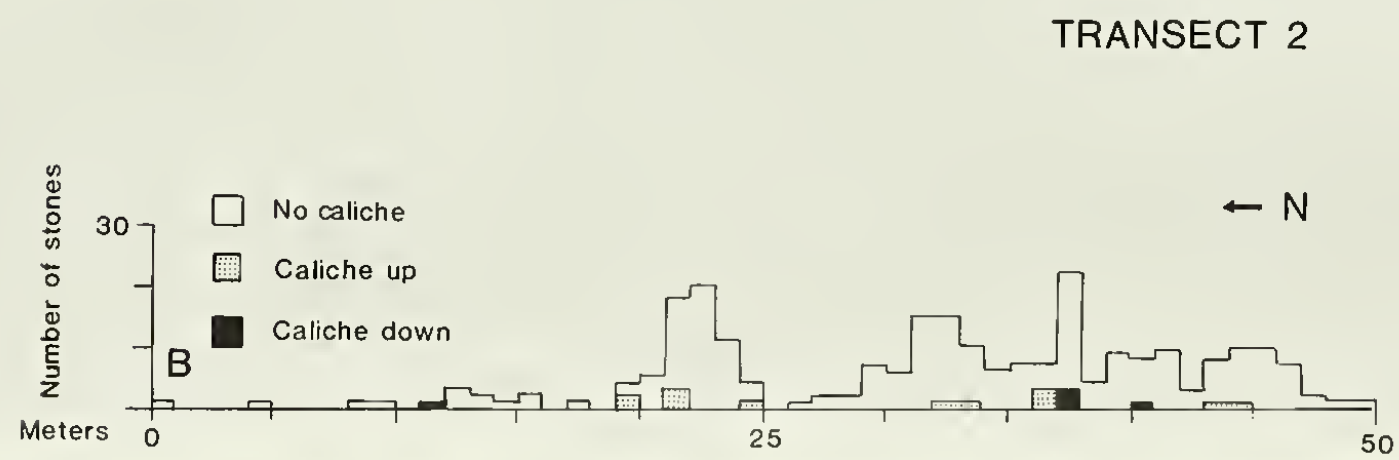
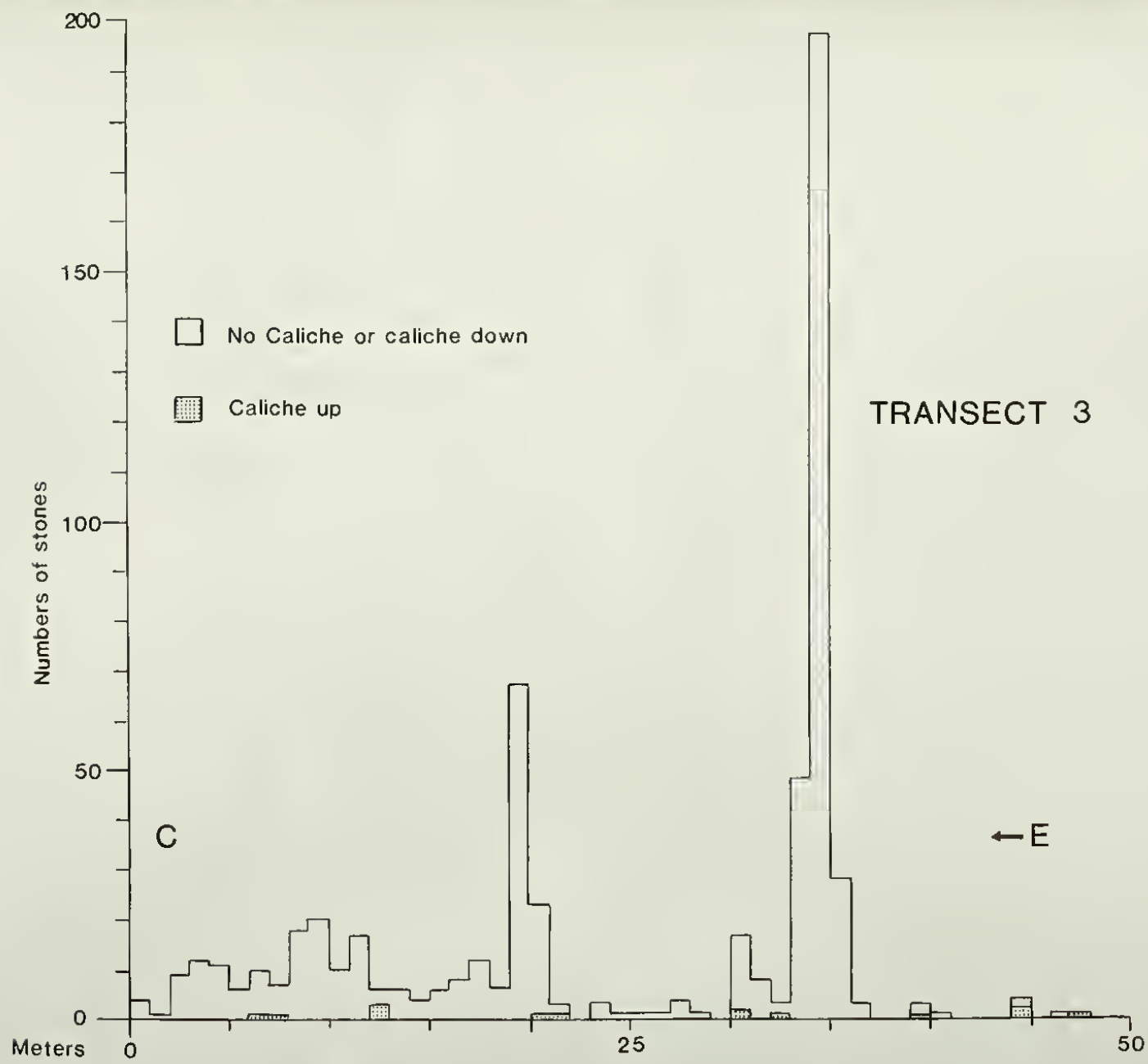


Figure 6-16. Histograms comparing frequencies of caliche conditions in stone counts across a prehistoric road.







stone was more than three times the length of the shortest axis; all other shapes were considered equidimensional for the purposes of this classification, even though many were obviously not truly equant in dimensions. The arbitrary decision to recognize and define only the two shape classes was made primarily for purposes of efficiency. This procedure was considered adequate to distinguish between flaggy sandstone bedrock fragments of tabular shape and lag gravel concentrates which were predominantly equidimensional. These two shapes comprised the primary types visible on the surface. The lag concentrates typically are contained within the lower portion of the unconsolidated sediments atop the buried bedrock surface. Sandstone occasionally present in the lag gravels is typically rounded by transport or weathering. Theoretically, a high percentage of tabular fragments would indicate intentional excavation into the bedrock below, or extensive cleaning of the roadway, whereas a high percentage of equidimensional stones might indicate less extensive road preparation.

The composition of stones was monitored as another test to allow differentiation between bedrock and lag gravels. The lag gravels typically contain varieties of plutonic and volcanic igneous rocks, occasional metamorphic lithologies, cherts, petrified wood, hematite concretions and sandstone. Since the predominant lithologies present in the area are sandstone and chert, only three composition classes were recognized, sandstone, chert, and other. Hematite concretions, although abundant, were classified as other. The interpretation that a high percentage of sandstone is indicative of more extensive preparation of the road is thought to be viable in most instances where substrate conditions are similar.

Caliche typically forms a thick coating on the underside of stones in the B_{ca} or C_{ca} horizons in incompletely indurated caliche deposits. It is important to note that the coating initially forms on the underside of the stone, for if a stone at the surface has a heavy coating of calcium carbonate on the uppermost side of the stone, then it may be reasonably assumed that the stone has been dislodged from its natural position. The caliche forms only in the B or C horizons of a soil in most conditions, therefore if abundantly present on stones at the surface it implies either erosion or cultural dislocation from some lower position in the solum. This statement is true only if abundantly present, for occasional caliche-coated stones may be brought to the surface by many natural processes such as rodent activity or root throw.

Three locations were chosen for the trial rock counts. These locations were approximately similar in soil depth characteristics, but differed slightly in bedrock characteristics, and particularly in visibility of the roadbed depression.

Transect 1 was located on the Pueblo Pintado to Chaco Canyon Road, approximately 12 m east of Trench 7 (Figure 6-18). Slope of the surface in this location is less than 3 degrees, and vegetation is primarily gramma (Bouteloa sp.), with sagebrush (Artemisia sp.) nearby. Although sagebrush is not present in the prehistoric road at this location, it is concentrated within the roadway in nearby areas, and in some locations the road may be easily delineated by this concentration (Figure 5-3).

The profile exposed in Trench 7 (Figure 6-19D) revealed that bedrock in this location is a sandy shale with thin lenses of friable flaggy sandstone. This is overlain by a mantle of variable thickness containing poorly sorted, poorly stratified sandy gravel. The gravels are separated from bedrock by an erosional surface and are overlain by a thin (eroded) late Pleistocene-Holocene soil developed on what appear to be comingled aeolian and slopewash materials. The transverse profile of the clearly visible roadway at this location is deep asymmetrical.

Some reservations were entertained about the suitability of this site for rock counts, because of its proximity to Pueblo Pintado. It appeared almost certain that prehistoric activities not necessarily related to the road would have modified the distribution and orientation of surface stones in the area. Eventually it was decided to conduct the transect count, despite potential problems, because proximity to Trench 7 permitted detailed monitoring of subsurface strata.

One of the objectives of this rock count was to test the reliability of subjective impressions of rock concentrations in road-marginal positions. Informal observation of the area prior to making the rock counts revealed that there appeared to be an increase in stones near the margins of the visible roadway.

Partial results of the stone counts are shown in Figures 6-15, 6-16, and 6-17. A marked increase in total stones is noted at both the northern and southern margins of the roadway. This increase is reflected by an increase in sandstone, "all other lithologies," stones having a caliche-up orientation, and all sizes of stones. Although not shown on the histograms, angular and rounded, and tabular and equidimensional categories also increase in the margin areas. In this example, therefore, all of the monitored criteria indicate disturbance at either side of the roadway.

Careful examination of the histograms allows the recognition of other, more detailed conclusions. The textural and spatial distribution of stones (Figure 6-17A) indicate that the roadway is the product of construction, and not merely casual mainte-

Figure 6-18. Aerial photograph showing concentration of sagebrush in the Pueblo Pintado to Chaco Canyon Road, west of Pueblo Pintado. A-Trench 6; B-Trench 7; C-rock count Transect 1; D-rock count Transect 2; E-Pueblo Pintado to Chaco Canyon Road; F-possible segments of prehistoric road; G-Pueblo Pintado Ruin.

nance cleaning. This conclusion was based on a pronounced increase in even very small stones in the berm area. If berms resulted from cleaning, then these activities were organized to the point of scooping even pea-sized materials from the road and placing them on the berms.

Examination of Figure 6-15 not only substantiates this conclusion but allows further refinements. The distributions of sandstone and "all other lithologies" are inequal at the two road margins. The southern (upslope) road margin has a slightly lower proportion of sandstone and greater proportion of all other lithologies than does the northern berm. The implications of this are understood when the stratigraphy of the area is examined. Figure 6-19D shows that flaggy sandstone lenses in shale are exposed at the bottom of Trench 7, which is overlain by a lag gravel composed primarily of the "all other lithologies" composition. Excavation into the roadway would initially expose this gravel, which, when placed in the berm area, would form the lowermost part of the berm. The flaggy sandstone bedrock would be the last material excavated from the roadway, and the last to be placed on the berm area, thus crudely reversing the natural stratigraphy within the berm. Therefore, had the roadway been excavated into bedrock, one would expect to find a higher proportion of sandstone at the surface of the berm area, such as on the northern berm shown in Figure 6-15. The apparent reversal of this situation on the southern margin of the road is explained by the observation that the stone increase in that area is largely derived from lag gravels originating at the surface by natural erosion of the southern margin of the road. The conclusion drawn from this distribution of lithologies is that the roadway was excavated slightly into the bedrock, with the excavated material being placed primarily on the northern margin of the road, forming a berm. Relatively small amounts of material may have been placed on the southern margin, and the increase in "all other lithologies" is in part the result of natural erosion of the southern margin of the road. Although not shown on the histograms, this interpretation is substantiated by the distribution of shapes of the stones. The north berm is characterized by a higher proportion of very tabular sandstone fragments which presumably is the result of excavation into bedrock.

After performing the counts it was discovered that human activities had, indeed, modified the distribution of stones beyond the north berm, as shown in the area of Meters 0-9. The monitored attributes of the stone counts in this area allow several interesting conclusions. Examination of the histogram in Figure 6-15A shows that there is a high proportion of sandstone rocks larger than coarse pebbles in the "disturbed area," as compared to the apparently undisturbed area south of the road (Meters 35-50). It appears that larger sandstone rocks (Figure 6-17A) have been introduced into the area; the slight increase noted for smaller rocks of other compositions was probably the product of churning and perhaps very minor excavation into the thin soil above the lag gravels at the time of disturbance, which was not as extensive as the subsurface disturbance presumed to be the result of road construction noted in the berm areas. This is substantiated by the fact that the stones in this area contain virtually no caliche coating (Figure 6-16A), there is a slight increase in sherds (4 sherds were recovered in the "disturbed area" of the transect), and some of the sandstone fragments are burned.

In many respects this was the most informative of the stone count transects. Although the road was readily visible in this location, the counts clearly demonstrated the efficacy of the method for defining the roadbed and providing information on construction techniques.

Transect 2 is only 100 m west of Transect 1 (Figure 6-18), but differs significantly in many characteristics. Slope is somewhat steeper, approximately 5-7 degrees, and the road possesses a shallow asymmetrical transverse profile. The location has been strongly affected by erosion, which has exposed lag gravels for most of the length of the transect south of the roadway, although the gravels do not form a discrete layer as in the Transect 1 area. Only an occasional stone was seen in the Trench 6 profile (Figure 6-19C), 6 m to the east of the transect. Bedrock is again a sandy shale, but contains no flaggy sandstone. The road is in a less-than-ideal location because of the slope and erosion, and it was anticipated that the use of stone concentrations as a means of identifying road margins would not be optimal in these circumstances.

Monitored attributes showed a consistently low proportion of sandstone and stones larger than coarse pebbles, and a very low proportion of stones in the caliche-up orientation (Figures 6-15B, 6-16B, and 6-17B). Indeed, only a very low proportion of the stones had any caliche coating at all. A marked decrease in total number of stones is seen north of the roadway in Meters 0-19.

A number of inferences can be drawn from the stone count data in this transect. The roadway can be delineated by stone counts, even in this eroded location. A northern berm is clearly, though not spectacularly, visible as an increase in total number of stones centered on Meter 23. The decrease in total stones between Meters 23 and 32 (note the 9-meter width between berm crests) is caused by deposition of post-abandonment sediments into the roadway. The increase in total stones on the northern margin and less obvious increase on the southern margin suggest that most of the excavated material may have been placed on the downslope side of the road, forming a berm similar to that seen in Transect 1.

The fact that counts of composition, size, and presence-absence of caliche were consistently similar on both road margins and in the eroded area south of the roadway suggests that excavation either did not penetrate bedrock or that the bedrock contained no resistant lithologies (which was verified by Trench 6). The low total stone counts in the area north of the road probably appear because the soil is less eroded and slightly deeper in that area, and not because of human activity. Caliche orientation and presence has relatively little value as an indication of disturbance in this particular situation because of the near - surface depth of the lag gravels, a position which inhibits modern accumulation of caliche and promoted degradation of earlier-formed caliche coating on the stones.

This transect demonstrates the importance of careful selection of transect locations to insure maximization of information return. Even in this relatively poor location, however, useful information pertaining to roadway delineation, width and construction was obtained through this procedure.

Transect 3 (Figures 6-15C, 6-16C, and 6-17C) was located on the Penasco Blanco to Ahshislepah Road in the vicinity of Trench 12 (Figure 6-19H). The slope in this location is approximately 3-5 degrees, and, although some erosion has taken place as evidenced by the thinness of the soil (15-20 cm) and occasional sandstone fragments on the surface, the erosion does not seem to be either modern or severe. This location was chosen because of the presence of a thin soil overlying a sandy shale with abundant flaggy sandstone and because, although the roadway could be accurately projected, no roadbed depression was visible. With the exception of hematite concretions there were virtually no lag gravels noted in the area of the transect. A moderate increase in larger stones (small and medium cobbles) was perceived at the projected road margins prior to commencing the count. There was no perceptible modification of vegetation other than perhaps a very slight increase (unmeasured) in snakeweed.

This transect demonstrates the value of stone counts for the definition of roadways with no visible topography, and provides a graphic demonstration of the fact that interpretatively significant characteristics of the stones will vary from transect to transect. In this particular transect the road margins were spectacularly defined by the total stones present and by the distribution of sandstone, less well defined by the count of stones larger than coarse pebbles, and very poorly defined by any of the other monitored characteristics (see Figure 6-15C, 6-16C, 6-17C).

Road construction is clearly indicated by the distribution of sandstone. The Trench 12 profile shows that shale containing flaggy sandstone lenses is present within less than 30 cm of the surface. There are no sandstone outcrops at the surface in the area of the transect or Trench 12; examination of Meters 0-19 and 37-50 shows that there is very little sandstone outside the road margins, and that which is present is mainly in the form of coarse pebbles or smaller. Simple cleaning of surface debris from the roadway could clearly not be the source of the sandstone noted at the margins of the roadway. The relative lack of caliche on any of the stones is presumably because the sandstone is so close to the surface that caliche had not formed on that material excavated for the road.

Several aspects of this particular transect are puzzling. Hematite (mainly in the form of small hematite nodules and small hematized sandstone fragments), increases in the area east of the roadway (Meters 0-19, Figure 6-15C). This is apparently the result of past erosion and is unrelated to road construction, although this cannot be demonstrated with certainty. It should also be noted that road width in this transect varies from the usual 9-10 m. The peaks in stone concentration occur at Meters 20 and 35, indicating a road width of approximately 14-15 m. Observation of the roadway at sunset shows, however, a very shallow, but slightly visible roadway depression between Meters 21 and 30, indicating a road width closer to 9 m. We can at present offer no explanation for the apparent placement of excavated material at some distance from what may be the actual road margin.

This transect is of particular importance because is demonstrates that rock counts can be used to delineate the roadway even when a roadway depression is not visible under most light conditions. In addition, it demonstrates the fact that constructed road segments are not always characterized by pronounced berms or roadway depressions. Had there been no sandstone in the substrate in this particular area, there would have been no evidence of construction preserved, thus possibly resulting in the mistaken conclusion that no construction had occurred.

A brief review of the results of the stone count transects reveals that this method offers a tremendous potential for recovery of information not available by other methods. The counts allow us to demonstrate or confirm that: construction has occurred, even where a roadway depression is not readily visible; in most instances the material present in the border elements was derived from the immediately adjacent roadway; most of the excavated material was placed on the downslope side of the road in sloping terrains; surface information can be used to determine relative depth of excavation; and some of the excavation must have been in the form of scooping loosened materials from the roadway.

Analysis of data from the various transects shows that the attributes to be monitored for

a given area should be tailored to that particular area in order to insure maximum efficiency and information return, since those attributes most effective in delineating the roads may vary from one location to another. For example, in all instances the total number of stones provided a means of delineation of the roadway. For more detailed interpretations, however, in Transect 1 a comparison of sandstone to "all other lithologies" provided useful information, whereas similar comparisons in Transects 2 and 3 were of limited value. Monitoring of caliche orientation was informative in the area of Transect 1, but was less productive in the area of Transects 2 and 3.

Although the issue of construction versus maintenance has been side-stepped by the definition of construction utilized in this report, the stone counts indicate that extensive construction, involving the movement of sand, silt, clay and stone, was done on the roads in some locations. Previous interpretations that the presence of border elements is dependent upon local geological conditions are correct in that border elements tend to be preserved in only some situations. The absence of border elements should not, however be taken as an indication that construction was not performed, but rather that there is no preserved evidence of construction.

Stone counts proved to be an effective source of information in this study, however similar counts will not be effective unless certain geological parameters are met: 1) The area must be relatively free of major erosion. This normally occurs on slopes of less than 5 degrees. 2) The soil or sediment mantle must be thin, normally less than 30-50 cm. 3) This mantle must overlie sandstone bedrock (preferably flaggy), shale with thin sandstone lenses, or bedrock of any type on which a residual lag gravel is present between the bedrock and soil or sediment mantle.

Trenching Program

Surface characteristics of the roads are often the only criteria readily available for interpretation of the primary character of the road. However, because secondary processes have greatly modified the road in most areas the validity of interpretation by surface characteristics alone must be questioned. Surface integrity of the road is controlled by the same factors that control visibility, namely the substrate type, orientation, position in the topography, past and present vegetation and climate, original character, and extent of reuse, among many others. Information pertaining to some of these variables can be derived from photointerpretation, surface investigations and archaeological context. Some types of information, however, are best derived from subsurface profile inspection. Excavation of trenches across the roads and examination of their subsurface profiles provided one means of testing the validity of surface observations.

The idea of trenching the roads was not original with this project. A number of investigators had previously trenched road segments in the Chaco Canyon area. Briefly, these include Vivian and Buettner, Windes, Loose, Obenauf, Ireland, Mathien, Brethauer and Marshall. For a more detailed discussion of previous trenching efforts the reader is referred to Appendix A. Many of the previous trenching programs resulted in the overall impression that relatively little information could be gained by profiling the roads, and that the trenches often presented as many problems as they solved. With few exceptions the trenches were interpreted as revealing little indication of a prepared roadbed.

The trenching program for this investigation was planned with several optimistic objectives in mind, including evaluation of different types and ages of roads, different types of substrates, and the effect of distance from major sites on road construction and use. Although these were worthy objectives, funding allowed excavation of only 12 trenches, which did not permit full examination of the above issues. The distribution of these trenches is shown in Table 6-4 and in Figures 8-4, 8-7, and 8-10 (except for Trench 6 and Trench 7).

All trenching locations were selected on the basis of a combination of photointerpretation and ground observation factors. Each trench was placed approximately perpendicular to the visible or projected road alignment and, on prehistoric roads, was of sufficient length to extend approximately 5 m beyond the road margin where border elements could be recognized, to ensure maximum potential exposure of the relationships between border elements and the original surface (Figure 6-20).

A scale drawing was made of the subsurface strata exposed in the wall profile of each trench (see Figure 6-19). Vertical control was maintained by use of a line level. Initially, profiles were drawn with no vertical exaggeration, but because length-depth ratios were quite large (ca. 20:1), and critical road features were often subtle and thin, most profiles were redrawn with a 2X vertical exaggeration. A sediment description was made of each stratum for at least two locations on each trench, one inside and one outside the road (sample descriptions are shown in Figure B-1). Recorded characteristics of the sediments and soils included Munsell color notation, structure, consistency, depth, boundaries, $CaCO_3$ concentration (field acid test), field determination of texture, and any other pertinent or unique physical characteristics that could potentially be of assistance in interpreting the geological history of the road.

TABLE 6-4

LOCATIONS OF TRENCHES EXCAVATED
ON PREHISTORIC AND HISTORIC ROADS

Trench 1 - North Road between Kin Indian Ruin and Escavada Wash.

Trench 2 - North Road, approximately 1 mile north of Kin Indian Ruin.

Trenches 3 and 4 - Paired trenches on possible parallel segments of North Road, approximately 2 miles north of Kin Indian Ruin.

Trench 5 - North Road, approximately 2 1/2 miles south of Pierre's Ruin. Not dug because of access problems.

Trench 6 - Pueblo Pintado to Chaco Canyon Road, approximately 150 m west of Pueblo Pintado Ruin.

Trench 7 - Pueblo Pintado to Chaco Canyon Road, approximately 100 m west of Pueblo Pintado Ruin.

Trench 8 - Abandoned heavily-used section of historic Black Lake Road near North Road and Leo's Hogan, approximately 1 1/2 miles south of Pierre's Ruin.

Trench 9 - Historic reuse area of North Road near Leo's Hogan, approximately 1 1/2 miles south of Pierre's Ruin.

Trench 10 - North Road, adjacent to Leo's Hogan and approximately 1 1/2 miles south of Pierre's Ruin.

Trench 11 - Penasco Blanco to Ahshislepah Road, approximately 2 miles WNW of Penasco Blanco Ruin.

Trench 12 - Penasco Blanco to Ahshislepah Road approximately 2 miles WNW of Penasco Blanco Ruin.

Trench 13 - Two-track historic road adjacent to Leo's Hogan and the North Road, approximately 1 1/2 miles south of Pierre's Ruin.

Figure 6-20. Typical trench dug across a prehistoric road. Trench lengths were variable, depending upon the presence or absence of border elements. In all locations the trenches extended beyond the perceived or projected margins of the historic or prehistoric road. Fence post is located approximately on the crest of an earthen berm at the prehistoric road margin.

Not all trenching locations were expected to be productive. In some instances the goal of identifying a former road surface was considered to be improbable because of substrate characteristics or modification by secondary processes, but it was felt that the sites should be tested as a check against our judgement in selection of trenching locations. It was felt that this testing should be conducted during this project to evaluate the merits of trenching in future mitigation procedures.

Although the trenches will not all be discussed individually in this report, a discussion of several of the trenches demonstrates the type of information return that is possible under ideal conditions. Three trenches will be discussed in some detail, Trenches 1, 7, and 8.

Trench 1. This trench (Figures 5-5, 6-20) was located in a relatively flat area betwee Kin Indian Ruin and Escavada Wash. This location was selected for a variety of reasons: 1) the road was prominently visible on both aerial photographs and from the ground, 2) berms were visible on both sides of the roadway, 3) the roadway was on a flat area which theoretically would favor preservation of the roadway in most conditions, and 4) the road segment was close to both Chaco Canyon and a road-related Bonito Phase site.

A stratigraphic cross-section of this trench is shown in Figure 6-19A. Examination of the trench revealed a surprisingly complex history for this particular road segment. The sequence and nature of events was determined using standard geological techniques of

analysis of stratigraphic relationships, depositional structures, sediment textures, and pedogenic characteristics.

The following discussion of the history of the road exposed in Trench 1 is arranged in the sequence of events as they occurred. Numbered events described here correspond to the numbers seen in Figure 6-19A. (1) Alluvial silts and clays are deposited. These sediments are locally laminated, but are mostly modified by post-depositional weathering and soil formation, and display prominent vertical fractures. (2) The roadway was excavated into these modified alluvial sediments. The exact depth of excavation is difficult to determine, but does not appear to have exceeded approximately 20 cm. The excavated material was placed at the sides of the road although only the western berm (Meter 13-16) is visible. Berm materials are similar in texture to the underlying alluvial materials, and are often difficult to distinguish from the alluvium because of these textural similarities and re-structuring of the berm sediments. (3) The roadway appears to have undergone at least one, and possibly two, episodes of cleaning while in use, as indicated by addition of sediments onto the original berm. These sediments are of a different color and texture than the original berm, and depositional structures are not characteristic of natural deposits. This "additional berm material" grades into natural deposits at the crest of the original berm. (4) The road is severely eroded by running water at some time following cleaning of the road. This is indicated by the truncation of (3) sediments, and the apparent removal of the eastern berm. The extent of erosion by running water can only be estimated, but it may have cut minor channels into the roadbed such as that at Meter 6.5. During the later stages of this flow (flood?) silt and clay were locally deposited within the roadbed. This was followed by (5) aeolian deposition of sand into the eroded roadway. Cross-beds within this deposit dip into the roadway and indicate that the wind was blowing from the west-southwest. Disruption of minor depositional laminae on the eastern side of this deposit suggest that the road was still being used at this time, although there is no other evidence to support this conclusion. (6) A second very large flow, unrelated to that of (4), modified the roadbed again. The relative lack of modification of (5) deposits suggests that the road may not have served as an effective conduit for runoff; sediment-bearing water could have flowed into the roadbed, where it was at least temporarily ponded, causing the deposition of its sediment load. Retardation of flow conceivably was the result of damming by aeolian deposits such as (5). Regardless of cause, sediment was deposited within the roadway, partially filling the roadbed depression. The "clay lense" shown near the center of Figure 6-19A and in Figure 6-21 presumably was the ultimate deposit of this episode. Other, similar water-lain sediments were later deposited atop the clay lense, further filling the roadway. All of the water-lain deposits are laminated, locally display cross-bedding typical of fluvial deposits, locally conform to the underlying topography, and, in general, indicate relatively slow-moving water. Note that the "clay lense" laps onto and over (5) deposits. (7) The road was repaired by addition of a "replacement berm" on the eastern side of the road (Figure 6-22). As is seen in the figure, the berm deposits are stratigraphically superposed on (6) fluvial deposits. The color, texture, and structure of the berm material is approximately the same as that of the original berm, but clearly could not have been derived from the roadway as the original berm presumably was. (8) Aeolian sand was ultimately deposited over the roadway and berms and was very slightly modified by pedogenesis.

The significance of stratigraphic relationships cannot be overemphasized in this discussion. Superpositional relationships between deposits (2), (5), (6), and (7) clearly indicate that the two berms were not emplaced at the same time. Sediment textures and depositional structures indicate the nature of the events in the sequence described, and allow the easy distinction between natural and man-emplaced deposits.

This trench is of particular significance because it demonstrates that a great deal of information can be learned from subsurface examination of the roadway deposits. In addition, it is the only presently known example of the repair of a road. This is important because it indicates that the roads were a dynamic entity in the Chacoan society. The roads were apparently maintained to a certain condition, and were not merely the result of a "one-shot" construction episode.

Trench 7. The location of Trench 7 was chosen because the road was easily visible, because there were surface indications of construction, because the geology of the area appeared favorable for interpretation of road deposits, and because of its proximity to Pueblo Pintado (Figure 6-18).

Examination of the trench (Figure 6-19D) revealed that bedrock in the area consisted of a sandy shale which contained flaggy sandstone lenses. An erosional surface above the bedrock was the location of a thin lag gravel deposit which consisted largely of non-sandstone lithologies. The lag gravels were overlain by and incorporated into a thin soil containing a prominent B horizon which was slightly argillic. A highly disturbed gravel deposit was present above a truncated bedrock surface at the southern end of the trench. The origin of this deposit is not understood, but some of the disturbance may have been cultural in origin.

The trench illustrates several characteristics of the prehistoric road in this loca-

Figure 6-21. Photograph of Trench 1 showing water-lain sediments deposited within the prehistoric roadway. These sediments are stratigraphically above the primary berm deposits and below the repair berm deposits. Layer indicated is the clay lense shown in Figure 6-19A.

Figure 6-22. Photograph showing relationship of (A) water-lain sediments and (B) clay lense (see Figure 6-21) to repair berm deposits (C).

tion. The road was excavated slightly into bedrock, truncating and removing the soil in the area of the road. The excavated material was placed at the side of the road, especially on the downslope (northern) side (Meter 0-5). Although some material may have been placed on the southern margin of the road, the "berm deposits" shown in the figure (Meter 12-18) are more properly described as disturbance of the underlying materials. In addition, a road utilization surface can be recognized in this trench. This surface, which extends from Meter 4.5-12.5, appears to be partially an excavated surface (Meter 7-12.5), and partially on a natural or very slightly excavated surface (Meter 4.5-7). In most areas the utilization surface is recognizable by the truncation of underlying deposits, but a "churned zone" is seen from approximately Meter 8 to 10. This zone possesses an abnormal admixture of small pebbles and finer textured sediments. Larger stones are absent, presumably because of human removal, whereas finer sediments are presumably absent because of deflation during utilization. There is no depositional structure within this zone, and its texture and character are probably the result of human activities and not of natural processes.

Trench 8. This trench (Figure 6-19H) was excavated to explore the possibility of using trench data to differentiate between historic and prehistoric roads. Flynn (1981) described a hogan (subsequently known as Leo's Hogan) in this locality as being unquestionably associated with the prehistoric North Road, which lies approximately 20 m to the west of the hogan remains (Figure 5-7). Because of the presumed association of this site with the North Road, the validity of the North Road as a prehistoric feature came into question. Because the archaeological evidence in the immediate vicinity of the site was inconclusive, it was imperative to develop additional criteria for distinguishing between historic and prehistoric roads. A series of trenches (8, 9, 10, 13) was dug across various roads in the vicinity of the hogan (Figure 5-7). Two of the trenches, 8 and 9, were excavated across demonstrably historic roads. Trench 10 was placed across the North Road, and Trench 13 was dug across a portion of the North Road that had clear evidence of historic use.

Trench 8 is placed across an unquestionably historic two-track road (Figure 5-7) which is the former Black Lake Road. Examination of the trench profile demonstrates that it is possible to differentiate between historic and prehistoric roads. A zone of platy soil structure (Figure 6-23) directly below the two rut areas is present to a depth of approximately 35 cm below the surface. This platy structure, where the natural soil units tend to form flat "plates" approximately concentric to the rut, is, in this instance, the product of compaction by wheeled vehicles, mainly wagons. Similar, but less strongly developed soil structure was found beneath a two-track road passing within 5 m of Leo's Hogan (not shown in Figure 6-19), and beneath the ruts caused by historic re-use of the North Road (Trench 13).

Platy structure can easily be distinguished from the normal prismatic soil structure observable in undisturbed areas outside the former roadway (Figure 6-24). However, platy structures can also be the result of natural pedogenic processes (such as frost heaving), and may resemble natural parting along depositional laminae. Field investigators should be aware of the distinctions between these various types of "platy" structures, which are summarized in Table 6-5.

Summary. In general the trenching program implemented for this project revealed a number of subsurface characteristics of prehistoric roads, including:

1. Post-utilization sediments deposited within the roadway are typically lighter in color and thicker than surface sediments outside the road in almost all the trenches.

2. Post-utilization sediments deposited within the roadway are typically sandier than surface sediments outside the road in almost all the trenches.

3. In almost all cases the prehistoric roadway can often be defined by a change in consistency (toward less compact) of sediments within the roadway.

4. Where soil mantles are thin there is a tendency for the bedrock to be weathered more outside the roadway (Trenches 2, 3 and 4; Alan Kosse 1982: personal communication).

5. The absence of a visible roadbed depression does not necessarily indicate a lack of construction (Trench 12).

6. Not one of the nine trenches on prehistoric roads had any suggestion of platy structure.

7. Every one of the historic roads, and even a cowtrail intersecting one trench, showed development of platy structure.

An understanding of geological conditions, sedimentation and pedogenic processes is critical to placement and interpretation of trenches on prehistoric roads. Many of the trenches excavated by previous investigators appear to have been located in geological situations which virtually precluded preservation of roadbed characteristics. In order to maximize the preservation and subsurface visibility of roads in trenches, future trenches should be located in: 1) areas of relatively flat terrain (less than a 3 degree slope, if possible), 2) areas having a well-developed soil possessing an argillic or stongly developed cambic B horizon, 3) areas having a soil or sediment mantle less than approximately .5 m in thickness, 4)

Figure 6-23. Photograph showing platy soil structure developed beneath an abandoned historic road. Note the slightly concave pattern of plates which has developed beneath one of the former ruts.

Figure 6-24. Photograph showing the contrast between peds having platy structure (A) derived from beneath the historic road as point (B), with peds having prismatic structure (C) derived from the same depth outside the roadway. Peds are held in approximately their natural orientation.

TABLE 6-5

COMPARISON OF PLATY STRUCTURES OF VARIOUS ORIGINS WITH DEPOSITIONAL STRUCTURES

Platy Structure Formed by Compaction Beneath Present or Former Historic Roadway	Platy Structure Formed by Natural Pedogenic Processes	Structure Resembling Platy Structure, Formed by Parting Along Depositional Planes
1. Plates may extend below 30 cm below the surface.	1. In this geographic area plates are seldom present more than 20-30 cm below the surface, or closer than approximately 5 cm to the surface.	1. "Plates" are not actual pedogenic structures.
2. Plates tend to form a concave pattern beneath the rut or path.	2. Plates are best-formed in stable soils or sediments having sufficient clay to fit into sandy loam or loam categories, although they may be formed in virtually all textures (Department of Agriculture 1951).	2. "Plates" conform to bedding planes which may or may not be parallel to the present surface.
3. Plates thin toward the surface.	3. There is no textural change between vertically stacked plates.	3. Vertically "stacked" "plates" may have slightly different textures or colors. Fine sand or silt will be the most common textures. The actual plane of parting is commonly along a slight texture change, or coarser lamina (Figure 6-21).
4. The dry consistence varies with texture, but dh to dvh are not uncommon (Department of Agriculture 1951).	4. Individual plates as well as the zone of platy structure conform to surface.	4. Colors are typically in the range of 7.5 YR 6+ or 10 YR 5+ [Munsell Color Co. (nd)].
5. Colors are the same as outside the roadway.	5. Colors are highly variable, although B horizon or A2 horizon colors predominate.	5. Color in any given area can commonly be traced to a distinct depositional unit boundary.
6. Structure classes of 2-3 are most common (Department of Agriculture 1951).	6. Platy zone may cross depositional, pedogenic or color boundaries.	6. Material seldom has a dry consistence of harder than dsh (Department of Agriculture 1951).
7. There is no texture change in vertically stacked plates except at pedogenic or depositional boundaries.	7. Dry consistence is extremely variable.	7. In some instances there may be a slight concentration of $CaCO_3$ along "plate" boundaries.
8. Plate thickness may vary markedly with texture and compaction. Plates may not form in loose sand.	8. $CaCO_3$ on parting planes is rare unless in a highly eroded area.	8. "Plates" may be present more than 30 cm below the surface.
9. Plates do not conform to surface, depositional or pedogenic boundaries.	9. Crossbedding in plates is not observed.	9. Cross-bedding may be present within individual "plates".
10. $CaCO_3$ is not present on parting planes in ordinary circumstances.	10. Occurrence is not restricted to any single depositional or topographic situation.	10. "Plates" are most commonly present in either present or former H_2O concentration areas.
11. The degree of platiness and depth is, in part, a function of amount of travel on the roadway. The aspect of time elapsed since usage of the road and its effects are incompletely understood at present.	11. Plates may have structure classes of 1-3, although 1-2 is most common (Department of Agriculture 1951).	11. "Plates" may have structure classes of 1-3, although most commonly will be 1 or 2 (Department of Agriculture 1951).
	12. Plates have a tendency to thin toward the surface.	12. "Plates" show no consistent tendency to thin toward surface.

areas having flaggy sandstone or shale with flaggy sandstone lenses beneath a thin soil mantle, 5) areas having a lag gravel concentrate between the soil mantle and the bedrock beneath. In summary, the optimum location for placement of a trench would be a formalized road developed in a flat area having a thin soil mantle above a flaggy resistant bedrock or lag gravel. Trench profiles should be examined and described by a person experienced in geology and pedology, as subtle pedologic differences and some structures are easily missed by the inexperienced observer.

Comparison with Coastal Peruvian Roads

Chacoan roads have usually been intensively modified by secondary processes. Because of this, it is often difficult for the observer to develop an image of what the Anasazi roads may have looked like in their primary condition. Comparison with other prehistoric roads of the world reveals that many possess a number of characteristics in common. One of the best examples of this is the prehistoric road system of coastal Peru, which very closely resembles that of Chacoan roads. Because of these similarities, and because the climate of coastal Peru (mostly less than 25 mm/yr precipitation) is more conducive to the preservation of cultural modification of the landscape, the prehistoric Peruvian roads illustrate particularly well how the primary characteristics of the Chacoan roads may have appeared.

One of the most thorough and original studies of Peruvian roads is by Beck (1979). Beck describes two basic types of Peruvian foot-travel systems, paths and roads. The distinction between paths and roads is an important one, not only in concept, but in recognition characteristics. Beck (1979:18) provides an excellent description: "Paths are geomorphic, following a route that is the easiest, most direct way between two geographical points...paths conform to the natural surface of the land and do not involve planned alteration of the course...the path is caused by the friction of feet with the earth." She further makes the point that labor investment involves only human judgment in deciding the easiest course to take. In contrast, prehistoric Peruvian roads may be geomorphic on occasion, but to a much more limited extent than paths, and involve a considerable labor investment, including surveying, engineering and construction. "Thus a road is planned and built, whereas a path is the result of wear" (Beck 1979:19).

The prehistoric road systems described by Beck are pre-engineered by first laying out the road and then doing construction. Although the roads may change direction, it is usually by means of an angular turn rather than a curve. Beck notes that the roads usually have one or several of the following characteristics: clearing, grading, lining, walls, or elevation above surrounding terrain.

Substrates are important in determining visibility and physical characteristics of the Peruvian roads, as is geomorphic position. Roads built on a sandy base are usually depressed, whereas roads traversing areas of desert pavement are cleared of stones (Beck 1979). Roads developed on alluvium are almost always partially or totally eradicated by large-magnitude flooding occurring with infrequent torrential rainfall during Ninos (Nials et al. 1979a, 1979b).

An additional observation of Beck's study is that "extreme attention must be paid to the natural configuration of the land. The man-made nature of road features is obvious to the observer as long as he is aware of the variety of forms that a road may assume and how to recognize them" (Beck 1979:21). Even in an area of exceptional preservation such as coastal Peru, the "road depressions, cleared surfaces, and lines of stones demarcating a road course cannot be seen until one is standing almost directly in line with a road. During a survey one has to pay constant attention to any pattern that might indicate a road and each zone must be criss-crossed..." to eliminate the possibility of missing road segments (Beck 1979:23). To emphasize the significance of this statement to the Chacoan road study, the reader should bear in mind that the Peruvian coastal desert is in many places singularly devoid of vegetation and consequently these roads are often much more visible than their Chacoan counterparts.

Peruvian roads are also similar to the Chacoan roads in the types of sites found in association. Beck notes that several types of architectural remains are associated with the roads: huacas (presumably administrative structures), isolated settlements with agglutinated structures, isolated structures with single or multiple rooms, and "windbreaks," which are similar in shape to Herraduras (see Chapter 9).

A final note concerning the similarities between these two prehistoric road systems: there is no implication in this discussion that Chacoan roads are an offspring of South American roadbuilding technology or vice versa. As previously stated the apparent similarities between Chacoan and Peruvian roads, along with the better preservation of the Peruvian roads, provide a model for the expected primary characteristics of Chacoan roads.

Chapter Summary

Examination of roads from both the surface and subsurface perspective has resulted in a compilation of attributes of prehistoric roads (Table 6-1). A morphological

classification system has been developed which facilitates the characterization of road elements and the evaluation of secondary modification of the roads. Results of the study indicate that many factors control the ground visibility of Chacoan roads, but the primary ones are degree of construction and formalization of the road and secondary modification as affected by depth to bedrock, substrate type, vegetation and topographic position.

It appears that the prehistoric roads were engineered and constructed. The possible remnants of a pre-construction surveying and demarcation system were found in some areas. Additional studies were performed which assisted in the location of the road and in the evaluation of the primary and secondary characteristics of the road. These studies, which included stone counts and trenching across the roads, showed that the roads were constructed in many places, even where surface indications of construction are not obvious. It was found that trenches placed in the correct location have the potential of allowing identification of utilized road surfaces in some instances, and in the proper types of substrate provide one of the few non-archaeologic means of conclusively differentiating between historic and prehistoric roads.

Examination of surface and subsurface physical characteristics of both historic and prehistoric roads has resulted in the formulation of a ground-based recognition guide for prehistoric roads which, when used in conjunction with archaeological data, allows the differentiation of historic and prehistoric roads in most, though not all, instances.

Several recommendations may be made for future studies of prehistoric roads. Geological, as well as archaeological expertise should be utilized as this greatly expands the interpretative capabilities of a field team. A geomorphologist is often able to separate natural from unnatural features in the landscape, and may be able to better evaluate whether a road segment has been constructed or not. It is also recommended that some type of standardized nomenclature system be used to characterize road elements. The system proposed as a result of this study, although imperfect, provides a mechanism for the organized discussion of the physical characteristics of roads. Future road investigations could probably benefit from a study of engineering aspects of the Chacoan roads, despite the elusive nature of the subject. Perhaps a study of low-technology "primitive" surveying methods might provide insight on the problem. A well-researched, thoughtful comparison with other, better-preserved prehistoric road systems such as that of the Peruvian coastal area may provide insight on the primary character of the Chacoan roads and the significance of roads to a society.

CHAPTER 7

CHAPTER 7

ARCHAEOLOGICAL INVENTORY METHODOLOGY

"Now those sage bushes were all about the same height--three or four feet; they stood just about seven feet apart, all over the vast desert; each of them was a mere snow mound, now; in any direction that you proceeded (the same as in a well-laid-out orchard) you would find yourself moving down a distinctly defined avenue, with a row of these snow mounds on either side of it--an avenue the customary width of a road, nice and level in its bredth, and rising at the sides in the most natural way, by reason of the mounds. But we had not thought of this. Then imagine the chilly thrill that shot through us when it finally occurred to us, far in the night, that since the last faint trace of the wheel tracks had long ago been buried from sight, we might now be wandering down a mere sagebrush avenue, miles away from the road and diverging further and further away from it all the time. Having a cake of ice slipped down one's back is placid comfort compared to it. There was a sudden leap and stir of blood that had been asleep for an hour, and as sudden a rousing of all the drowsing activities in our minds and bodies. We were alive and awake at once--and shaking and quaking with consternation, too. There was an instant halting and dismounting, a bending low and an anxious scanning of the roadbed. Useless, of course; for if a faint depression could not be discerned from an altitude of four or five feet above it, it certainly could not with one's nose nearly against it" (Twain 1872:230-231).

Over a century ago Mark Twain experienced and described the dilemma of the survey archaeologist attempting to locate an imaged linearity on the ground. Although the consequences of failure to locate the prehistoric alignment are not so severe as in Twain's situation, the frustration levels are nonetheless very high.

In addition to presentation of the basic methods utilized during the survey aspect of the project, this chapter contains a discussion of field problems unique to documentation of the roads. The survey crew found that many of these problems could not be simply resolved and laid aside but were recurrent themes which had to be addressed in developing an effective methodology. Since the 800-year-old roads under study here could not usually be "seen" by the survey crew, the methods utilized for survey de-emphasized the importance of the physical evidence of the road surface itself. Instead the methodology focused on the cultural character of the road which could be documented independent of the photo- or ground-visible alignment. Thus the success of the methodology was not predicated on "finding" or following the road as a physical swale or depression, but rather as a patterned distribution of cultural materials on the surface. Recording procedures had to be sufficiently thorough to allow for an accurate determination of the cultural affiliation, age and function of the located features.

Field Problems

Visibility of the Road

None of the roads identified to date are continuously visible as "swales" or depressions on the landscape. They are always discontinuous, with distances of over a mile or two between visible swales being common. Swales vary in length from 20-30 m to several hundred meters, and to the unaccustomed eye the majority is barely distinguishable from topographic or historic features.

To enhance the visibility of the road from the aerial, surface and subsurface perspective was the underlying goal of all the methodological approaches used for this project. To increase visibility from the aerial perspective, low sun angle photography was taken at different scales, and explicit criteria were established for screening obvious historical and natural noise from consideration on the aerial photograph (see Chapter 5).

To increase road visibility from the ground perspective, a number of aspects of field recording were emphasized. First, the configuration of artifactual scatters was enhanced through the use of pinflags, which served to clarify the relationship of the scatter to the alignment. Second, care was taken in the recording of what might otherwise be considered "ephemeral" remains such as isolated artifacts, small scatters, and masonry concentrations. Determining the precise location of sites was also considered a high priority, since at times the presence of the alignment was maintained only by the nature and configuration of the cultural materials found along it, and recording their location was in essence recording the location of the prehistoric road. The use of high flagged lathe poles to mark the documented centerline facilitated back-sighting and was another enhancement device sometimes employed. Local geological evaluation, surface rock counts and subsurface test trenching in certain locations were invaluable in allowing us to increase the geological visibility of the roads. Finally, observations concerning vegetation differential, its nature, and the geological factors affecting its occurrence were also made.

It is important to remember that in many cases it is possible to maintain the visibility of the road by recording secondary types of information even when the actual swale or physical depression has "disappeared". The consistent application of

procedures over a distance of several miles eventually results in a cumulative picture of road characteristics.

Use of Imagery

While the use of aerial photography in the field is by no means unique, there are certain problems which are unique to road work. The first is simply the selection of the proper set of imagery. The visibility of roads on the imagery is highly variable and it is essential to carefully compare what is available to make the best selection for the situation at hand.

Once in the field with the photos, problems with the scale, quality and date of the photos begin to emerge. Paradoxically, even though a particular set of imagery may be best for identifying the presence of a prehistoric alignment, that imagery is not necessarily the best for use in the field. For example, many of the road segments are most visible on the 1930s aerial photography taken for SCS. However, this imagery is very difficult to use for establishing anything other than general location on the ground, mainly because of the scale (1:32,650) and the changes in the landscape which have occurred since it was taken. The ideal solution may be to contract for new imagery of a project area, at variable scale and low sun angle. This will speed up the process of field inventory, and increase the accuracy of locating both the prehistoric alignment and prehistoric sites.

The role of the field archaeologist as "ground checker" for the photointerpreter is a valid one, but ceases to exist if it is ascertained that what was seen in the aerial photo is not, in fact, visible on the ground. The role is even more tenuous if the quality of the photo is such that ground-to-photo correlations are difficult to establish for any but the most obvious features. Since in most cases a contemporary image is not being used, it is extremely difficult to convey results back to photointerpreters in a manner which will serve to increase their ability to distinguish prehistoric roads in older photographs. There is no substitute for frequent visits to the field by the photo-interpreters to develop their abilities. By the same token, field personnel need to frequently re-examine photos during and subsequent to archaeological inventory. In looking at aerial photography, it is a truism that "the more you look the more you see," especially for the untrained archaeologist. Field observations can greatly heighten one's sensitivity to the photographed image, and often linear features can be "discovered" in the photographs after being initially indicated on the ground. This is especially important in light of the fact that there seems to be a potential for "doubles" or parallel roads to be occurring within about 100 m of each other in a number of locations (see Chapter 6). Clearly, precise control over ground observations and faithful adherence to the photographed image are necessary if this phenomenon is to be documented.

The ground observer, intent on verifying a road on a segment by segment basis, is placed, at times, in the extremely frustrating position of "knowing that something is there" as demonstrated by the photographed image, but not being able to see the tangible reality in front of him. It is at this point that the observer might begin to imagine that he sees a swale, using what has been dubbed here the "Rorschach Approach" so aptly described in the passage by Mark Twain presented at the beginning of this chapter. Although it is surprisingly easy to locate features which might be swales, the field archaeologist must keep in mind that his primary role is to record only what he can see and measure. If one has used aerial imagery to the best possible advantage, maintained control and accuracy over location of visible features in the field, performed careful and systematic inventory of cultural materials, and the alignment is still not visible on the ground either as a series of visible swales or as a series of cultural phenomena, then it can be confidently stated that the prehistoric road is not a tangible resource from the surface perspective in that location. It is not always possible to reconcile the photographed image with the ground reality, nor is it always essential to do so if the basic inventory approach is sound and well-executed.

Levels of Inventory

Determination of the appropriate level of inventory is probably the most critical methodological decision made during the course of fieldwork. (This is also discussed in Chapter 4 and Chapter 10.) Two main types of field inventory, reconnaissance survey and the intensive survey, were utilized in this project.

When used for roads inventory, the reconnaissance survey involves selecting portions of a specific road which appear to be potentially ground visible. Spot field checking normally involves driving to a selected location and attempting to locate either the imaged swale or cultural features which might potentially be associated with it. More extensive forms of reconnaissance may involve "walking the road" for several miles. To perform an intensive survey of the road alignment the corridor survey technique was devised, involving the definition of a survey corridor of a consistent width (generally 1/8 mile) on either side of the center of the prehistoric alignment as it appeared on the aerial photograph. All of the area inside the corridor was intensively surveyed, and observations were recorded using a standard format. Maps of survey corridors established around portions of the North, Penasco Blanco to Ahshislepah, and South Roads are shown in Figures 8-4, 8-7 and 8-10 (back pocket).

From a planning standpoint, the reconnaissance survey is appropriate when the goal is to establish the prehistoric validity of the imaged alignment, to assess geological and vegetational factors affecting the overall visibility of the road, and to gain a general idea of the "cultural environment" of the road (i.e., how many sites of what types there are in the general vicinity). All of these factors can greatly affect the ease with which the road can be surveyed, and the resulting costs of that survey. In addition, if new aerial photos are planned, reconnaissance survey of selected portions can help determine the precise location of the alignment. The purpose of the intensive survey, on the other hand, is to provide precise data concerning the nature of the road alignment, its location and characteristics, and the nature and location of sites and features. This level of information is generally required to establish a comparable data base, evaluate the significance of the road, and develop mitigation measures.

There is one important factor which can invalidate the reconnaissance survey approach as a means for verifying the presence of a prehistoric alignment. This factor is road visibility. Although the road is never continuously visible, in many cases it is possible to "project" a bearing from a visible swale and in so doing arrive at another visible swale a short distance away. If the nearest visible swale is as much as a mile away, however, this approach generally will not work. A comparison of bearings of visible swales along a single alignment often shows 10 to 15 degrees of variability. By "following the bearing" of a particular swale, one can quite easily project off into "space" in a very short distance. One may feel confident that one is following the alignment because the course is continually "corrected" to match the general road alignment as marked on the topographic map. In reality, however, the mapped alignment may be several tens of meters off (due to errors in map transfer, and other mapping inaccuracies).

This can lead to one of two tendencies. On one hand, it can lead to a false sense of security and a tendency to designate any prehistoric sites encountered as "road-related" and any minor topographic depression as a swale; or, if nothing is found, it can lead to the opposite conclusion, that the prehistoric road does not exist in that location.

As indicated earlier, there are ways to "enhance" the visibility of the road using certain recording and survey techniques; however, these techniques are not amenable to the reconnaissance survey approach to fieldwork. Under "worst case" visibility conditions, the careful accumulation of diverse types of evidence within a controlled survey corridor is felt to be essential before a reasonably reliable judgement as to the verification of the prehistoric alignment can be made.

This discussion is particularly important in determining the appropriate methodology for small project surveys, in situations where there may be an alignment projected into an inventory area. Chances are that no visible swale will appear on the aerial photography, and a reconnaissance survey may yield negative results. In such cases, the best approach may be to plot the projected alignment as accurately as possible on the topographic map, establish a survey corridor, and perform an intensive inventory within that corridor. (It is also generally advisable to supplement this approach with a "back-up" reconnaissance survey of probable areas, such as ridges, saddles, topographic breaks, areas of level, shallow soils, etc.) The advantages of the corridor approach in this situation are that: 1) it increases the margin of error, allowing one to miss the actual alignment by quite a distance and still pick it up within the corridor established around the projected alignment; and 2) it increases one's sensitivity to ephemeral cultural variability which might be patterning along the alignment.

General Methodology

Phases of Fieldwork

Fieldwork proceeded in three general phases. The first phase was a reconnaissance survey which took place from June to September 1981. During this phase, the general alignments of the North Road from Kutz Canyon to the Escavada Wash, the Casa del Rio to Lake Valley Road, the road from South Gap to Kin Klizhin, the road from South Gap to Kin Bineola, the road from Pueblo Pintado south to Chacra Face, the road from Pueblo Pintado east to Chaco Canyon, and the Penasco Blanco to Ahshislepah Road were walked. Field personnel in this phase included Ben Robertson, John Stein, Daisy Levine and Denise Galley. In cases where visible segments were not located, the alignment was "followed" as a compass bearing, although many times the actual location of the alignment was uncertain. Note taking was relatively brief and few sites were recorded.

The second phase of the fieldwork began in September 1981 and involved intensive corridor documentation of portions of the North Road (from the Escavada Wash to Pierre's Ruin), the Penasco Blanco to Ahshislepah Road (from the cliff northwest of Penasco Blanco to the Ahshislepah Wash) and the South Road (from Upper Kin Klizhin to a point just south of La Mesita de la Junta). Field personnel involved in this phase were John Stein, Daisy Levine and David Simons.

A third phase involved informal reconnaissance of selected areas thought to have a high potential for containing road alignments, Bonito Style structures or other road-related features. In many cases these areas represented "gaps" between known road

segments near priority management areas, or areas along major road systems which had never been studied. For the most part this reconnaissance was undertaken by volunteers, who coordinated their efforts with project personnel. The names of surveyors and the areas examined are as follows: Michael Marshall and Chris Kincaid performed a reconnaissance of the lower Kimbeto area; Michael Marshall and William Kight investigated the Zuni Salt Lake Road, the Escavada Wash in the vicinity of Bis'a'ani ruin, and the Chacra Face Road from Fajada Gap to Red Mountain; and Michael Marshall, Dabney Ford and Cory Breternitz performed reconnaissance in the Casa del Rio, Lake Valley vicinity, and walked the Ahshislepah Wash from the "ramp" of the Penasco Blanco to Ahshislepah Road to its confluence with the Chaco Wash.

These efforts resulted in the documentation of 26 sites on the Fajada Wash, including 3 potential Bonito Style structures along the alignment of the Chacra Face Road. Kimbeto Point in the lower Kimbeto Wash area, and Los Aguages, a structural site on the Penasco Blanco to Ahshislepah Road were also located at this time. Perhaps most important was the identification of "voids," where Anasazi cultural materials appear to be lacking. Documentation of survey results is on file at the Laboratory of Anthropology in Santa Fe.

Intensive Survey Methodology

Field methodology for the intensive survey was generally consistent with standard methodological approaches currently followed in the San Juan Basin. During the intensive survey aspect of the project two and sometimes three surveyors comprised the crew. Survey of the delineated corridors was accomplished by walking transects parallel to the prehistoric alignment. If a visible swale was present, it was walked for an arbitrary distance and the center flagged and staked. The centerline of the prehistoric alignment was surveyed first. Following survey of the centerline, the survey crew flanked the alignment and completed the survey of that portion of the corridor. Spacing between crew members ranged from 10 to 30 m depending upon the ground cover and terrain.

Personnel

Unique aspects of roads inventory make the acquisition of specialized expertise especially important for the viability of a field project. Three types of expertise are essential. First, the archaeological crew should include personnel capable of identifying in the field the majority of ceramic types commonly found in an area. This is especially important when collections are not made, a policy strongly advocated to preserve the visibility of the road alignment. It is also imperative that a geologist be available for consultation with the field crew, preferably he or she would also accompany field personnel during the majority of the fieldwork. The need for a geologist is amply demonstrated by the substantial contribution which the geological perspective has made to the current project. In addition to sharpening the ability of the crew to distinguish between natural and cultural features, the geologist can explain and interpret natural transformation processes which account for observed variations in the characteristics of the alignment (extraordinary depth, lack of depth, variability in visual signature, irregularities in swale configuration, etc.). If subsurface testing is planned, as may be necessary to validate the prehistoric nature of the road or to assess construction techniques, it is absolutely essential that these situations be evaluated by a qualified geomorphologist, preferably one who is experienced in studying and working with archaeological information. Recognition of minute changes in soil texture, structure and consistency which are indicative of age and maturity is beyond the capability of archaeologists who have not had extensive geomorphological training.

A third type of expertise considered essential is that of a trained photo-interpreter. This is particularly important in the process of "searching" for prehistoric roads within a specified area. This type of situation might occur when a road is "projected" through or suspected in an area, but no segments have been identified on aerial photography. As with the geological consultant, it is imperative that the photointerpreter have experience in the recognition of prehistoric phenomena, preferably in the recognition of prehistoric roads.

Equipment and Field Procedures

For the purpose of defining the survey area and establishing ground location, 7.5' topographic maps were carried, supplemented by aerial photographs. Archaeological manifestations which were plotted on the topographic maps were later transferred to blue-line map enlargements.

Two crew members carried Brunton compasses which were utilized primarily for triangulation of cultural materials while in the study areas. Triangulation points were established prior to survey to facilitate accurate location of materials. The Brunton compass was sometimes utilized to orient transects in the absence of a visible alignment, and to record the bearing of visible segments of the roadway. A tripod for the compass was used during occasional piece-plotting of surface material scatters and mapping of small architectural manifestations. The crew was equipped with two 50-meter tapes used for accurate measurement of sample areas, structural measurements, segment length measurements, and plotting of swale profiles. In addition, 3-meter tapes were utilized primarily for

documentation of structural remains, laying out sample grids and measuring of swale profiles.

A length of heavy-duty cotton string and a line level attached to two chaining pins were utilized for measuring cross sections of individual swales (Figure 7-1). Photographs were taken of sites where necessary, utilizing a 35mm single lens reflex camera. Many aspects of the roads were photographically documented with color slides.

Maps were made of the sites utilizing a protractor, an engineer's rule, and occasionally an alidade. Each site was staked utilizing a 1"x2"x12" wooden stake labeled with a stamped aluminum tag. Pin flags were utilized extensively to enhance the configuration of material culture scatters, and to establish their relationship to the prehistoric alignment (Figure 7-2).

Data Recording Forms

Several special data recording forms were generated for use in the field; during the course of the project the utility of some forms was reevaluated and the forms modified or dropped. Among the forms dropped were the Imaged Segment Form (designed to provide feedback to the photointerpreter for each imaged segment) and the Survey Unit Form (designed to summarize survey results for subdivisions of the survey corridor). It was decided that both forms were superfluous. Ultimately, only two forms were consistently utilized in the field: the Site Data Form and the Visible Segment Form. Only the Site Data Form will be discussed here; the Visible Segment Form (for recording visible swales) is described in Chapter 6.

The Site Data Form was a composite of data forms utilized on other projects, and was designed to cover all types of archaeological manifestations including visible segments of road. This form was supplemented by a format for documentation of lithic and ceramic information. Archaeological material which did not qualify as a site was recorded in an attenuated narrative format as an Isolated Occurrence. An example of a Site Data Form is presented in Figure 7-3.

Material Culture Analysis

No-Collection Policy. The analysis of all material culture was completed in the field; a no-collection policy was strictly adhered to during documentation of the various road systems. The rationale for this policy is related directly to the fragile character of the road alignment as an archaeological resource and to the need to provide for future research needs. It is acknowledged that there are advantages and disadvantages to this approach; discussions can be found in Chapman and Enloe (1977), Butler (1979), and Grigg and Enloe (1981:69-72).

From the standpoint of roads research, the disadvantages of a no-collection policy are primarily three-fold. First, not making collections precludes the possibility of subjecting the materials to micro-analysis as an assemblage. Second, assemblages from the different road systems cannot be physically compared. Third, assemblages or individual pieces from the road systems cannot be subjected to the scrutiny of other professionals.

It was felt, however, that the disadvantages of a no-collection policy were outweighed by the advantages. A collection strategy would have inalterably affected the character of the artifactual distribution on the roads. Taking future researchers into consideration, the project was obligated to adhere to a preservation ethic, and alter the character of the road as little as possible. The no-collection policy was certainly cost-efficient. It did result in consistent and comparable information from artifactual assemblages sufficient for making preliminary observations and conclusions as to the character of the Anasazi roads. It was the study team's judgement that road research was not sufficiently well-developed to justify collection of material, a procedure which would constitute destruction of the primary characteristics of the road alignment.

Sampling Procedure. Sampling decisions were judgemental and were generally made on a site by site basis. These decisions were predicated on 1) density and distribution of material items; 2) internal composition of the assemblage; 3) overall size of the site; 4) presence of multiple features; 5) presence of non-contemporaneous spatially distinct proveniences; and 6) the context of deposition (e.g., midden, activity locus).

Sampling decisions were made based on an assessment of the characteristics and density of material culture on a site surface, aided by the use of pin flags to mark the locations of individual artifacts. Location of sample areas was determined by patterning or clustering in material culture; the type of sampling procedure and size of the sample unit were determined by the density of material. The types of procedures utilized included the grab technique, quadrat sampling and artifact tallying.

The grab technique was used when site size was large and material density was low. Generally the total surface assemblage was documented if fewer than 100 items were present. All low-density items such as diagnostic lithic artifacts and ground stone were recorded. In a midden context where ceramic density was high but lithic density was low, the total lithic assemblage was documented.

Quadrat sampling was utilized primarily for assessing the density of ceramic material, either in a midden context or in a dense activity-related scatter. Quadrat size was predicated on perceived surface density and was designed to monitor at least 100 sherds per unit. A 2x2 m unit was commonly used on

Figure 7-1. Field crew in the process of measuring dimensions of a ground-visible segment of the North Road near Pierre's Ruin.

Figure 7-2. Photograph showing the linearity of a road-associated ceramic scatter visually enhanced through the use of pin flags.

BLM CHACO ROADS PROJECT: SITE DATA FORM

Road: Recorder: Date:

Field No._____ Aerial Photo Ref._____

BLM Site No._____ LA No._____

Associated Segment No._____

USGS Quad: T R _____of_____of _____of Sec._____

UTM Zone_____ N E
N E

Elevation: Primary Drainage:

Physiographic Situation:

Exposure: Slope: Soil Structure:

Vegetation:

Location Description:

Site Type: Cultural Affil.: Temporal Affil.:

Number and Relationship of Proveniences:

Site Dimensions:

Additional Forms:

Distance and Direction to Prehistoric Road Alignment:

Visible Horizon:

Distance to Major Anasazi Community:

Site Condition:

Sample Description:

Photos:

Site Description:

Figure 7-3

MATERIAL CULTURE SUMMARY
BLM CHACO ROADS PROJECT - SITE DATA FORM, PAGE 2

Site Number: Site Type:

Ceramic Summary: Locus Description:

Lithic Summary: Locus Description:

Historic Artifact Summary: Locus Description:

Groundstone Summary: Locus Description:

Figure 7-3 (Concluded)

a midden surface with moderate material density. Each midden was sampled separately and multiple samples per midden were utilized if material samples in the quadrat were lower than 100 pieces. Placement of the quadrats was recorded on the site map.

During the reconnaissance phase of this project, material culture (ceramics, lithics, historic items) was documented via a tally system which preserved artifact provenience in large arbitrary units. During the survey of the designated corridors, this system was modified for documentation of Isolated Occurrences, defined either as isolated artifacts or as limited scatters of material. Provenience was determined by triangulation onto a 7.5' topographic map. A form of the tally system was also utilized for a series of six transects parallel to the axis of the Penasco Blanco to Ahshislepah Road. All items of material culture were recorded within these transects in a tally fashion without maintaining specific provenience.

Historic Material. Accurate location and dating of historic material was necessary to adequately address the possibility of an historic origin for the roads. Because the roads were visible in 1930s aerial photography, analytical emphasis was placed on temporal identification of individual artifacts and assemblages predating this period and post-dating 1868 (when wagons were introduced into the area).

Historic material culture was monitored for functional and temporal information. Following the arrival of the railroad in the Southwest in 1880, mass-produced goods became widely available to all local populations. Dating of this material can be accomplished easily by monitoring certain time-sensitive attributes of items such as bottles and cans which were often quickly discarded after use (Abbink and Stein 1977). For example, container attributes dating to the turn of the century include hole-in-top soldered seam cans (pre-1920); purpled, aqua and amber glass; and bottles where mold seams do not continue over the finish (pre-1903). Purpled glass bottles post-dating the introduction of automatic bottling machines post-date 1903 and pre-date 1914. Beer and soda cans post-date the 1940s. Discussion of these and other attributes can be reviewed in Ward, Abbink and Stein 1977; Abbink and Stein 1977; Rock 1981a, 1981b; and Fontana and Greenleaf 1962.

Documentation of historic materials was accomplished in narrative format with a list of diagnostic artifacts and attributes generated for each site. No specific sampling procedure was utilized. Assemblage characteristics and context of deposition was recorded. Concentrations of materials were mapped in a manner consistent with that of lithic and ceramic manifestations.

Lithic Material. Analysis of lithic artifacts was also accomplished in the field. Lithic detrital material was analyzed for material type, evidence of use, and level of reduction. Reduction was classified as either: 1) primary reduction, where cortex was present on 100 percent of the dorsal surface; 2) secondary reduction, where multiple flake scars are present but cortical surface is still visible; and 3) tertiary reduction where no cortex is present. All formal flaked stone tools and ground stone artifacts were recorded.

Lithic material was located as isolated finds, as functional assemblages with or without associated features, or in a midden context. In non-structural archaeological locations where lithic material was present, the distribution of tools and detritus was monitored through the use of pin flags. Often, different colored flags were utilized to differentiate between lithic and other cultural material on the ground surface. Because of the consistently low number of lithic artifacts in a non-structural context, the entire lithic assemblage was often documented. Where this was not possible, defined sample areas in the form of quadrats were utilized to control the documentation procedure. In a midden context the lithic detritus was documented by material type only. Documentation of the lithic materials within the ceramic sample quadrats allowed estimations of overall density. If time permitted, total lithic counts from the middens were documented.

Ceramic Material. As with other types of material culture, ceramic materials were recorded in the field. Forms were filled out for each provenience, controlling for vessel form and ceramic type. More information concerning techniques of ceramic classification is presented in Chapter 9.

Chapter Summary

The inventory of prehistoric roads requires a number of specialized field techniques. The problem of poor ground visibility of the road can sometimes be overcome by careful documentation and observation, and the use of survey methods designed to enhance the visibility of the alignment. While aerial photography is helpful in establishing the general location of the prehistoric alignment, its use can be frustrating if it is the sole focus of the inventory process, to the exclusion of other types of evidence. The decision as to the level of inventory needed depends to a large degree upon the visibility of the road and the management need. Often, intensive inventories of at least a portion of the alignment are needed to collect sufficient information to address road verification.

Fieldwork strategies were generally consistent with intensive inventory procedures used elsewhere in the San Juan Basin, with some exceptions. It was particularly important to have specialized expertise in the areas of ceramic identification, geomorphology and

photointerpretation on or accessible to the field crew. This was needed 1) to allow for on-site analysis of ceramic material, 2) to assist in evaluating the visible segments, and 3) to assure accuracy in photointerpretation. In future inventory projects, it is strongly recommended that a no-collection policy be followed because the location and configuration of material culture scatters is often critical evidence in establishing the location of the road alignment itself.

CHAPTER 8

CHAPTER 8

ROAD CORRIDOR DESCRIPTIONS

North Road

Introduction

The North Road is the westermost of five conspicuous linearities which radiate from the gate in the north wall of Pueblo Alto. The road leaves the gate at a bearing of 13 degrees (true north) and is clearly visible on aerial photography as far as the Escavada Wash, a distance of 3.5 km. From Pueblo Alto (elevation 6440') to the Escavada Wash (elevation 6140') is a maximum drop in elevation of 300' (91.4 m). At a point 3.1 km from the gate and 400 m from the wash margin the road makes a bearing change to approximately 360 degrees and deviates little from this bearing for 46.4 km (29 miles), where it enters the Kutz Canyon badlands. From here it is commonly believed to run down Kutz Canyon, past Twin Angels Ruin to Salmon Ruins. The alignment of the North Road closely parallels the division between R. 11 W. and R. 10 W., and pursues this course through five townships.

The landscape north of Chaco Canyon can be generally characterized as rolling sage-covered plano broken by vast stretches of badlands flanking the major drainages. Excluding the badland surfaces, soils are uniformly a sandy loam. The North Road is most visible on the ground from 2.7 to 5.8 km south of Pierre's Ruin, where the prehistoric alignment "cuts" a series of transverse dunes (see Figure 5-7).

From a surveyor's standpoint, the setting of the North Road was a difficult one, lacking features useful for triangulation and ground orientation. Excluding the far horizon, major topographic features visible on the skyline from the North Road include El Huerfano and Angel Peak to the north; Tse Nizhoni and Tse Ka'a (Section 34, T. 22 N., R. 12 W.) to the west; and the confluence of the Chaco and the Escavada Washes, the rim of Chaco Canyon, and Pueblo Alto to the south.

Previous Research

The North Road is part of the northern road system connecting the Escavada aspect of the Chaco Canyon complex (referred to as Chaco North) with the central Canyon via Pueblo Alto. During the late nineteenth and early twentieth centuries, the North Road was apparently quite visible as it passed Kin Indian Ruin on the north rim of the Escavada Valley. Mrs. Wetherill's comments on the North Road (Vivian 1948, see also Chapter 3), indicate that it was quite visible under certain lighting conditions (no doubt sunrise and sunset). Although it was known during the Wetherills' time that this road ultimately connected Chaco Canyon with the San Juan, ground studies of the road were not carried northward beyond Kin Indian Ruin until 1974 (Appendix A).

In 1973 Dr. Cynthia Irwin-Williams obtained new color and infrared imagery with the intent of documenting roads out of Salmon Ruins where excavations were then taking place. Using this imagery, in 1974 Pierre Morenon was able to follow the North Road alignment as defined the previous year by the National Park Service, Chaco Center Remote Sensing Project. Morenon was concerned with verifying the existence of the road by demonstrating that artifact densities were higher on the road than off the road. He defined the prehistoric alignment as being 100 m on each side of the prehistoric "centerline" (Morenon 1975:12), and used this criterion to determine placement of his sample units. Ultimately, Morenon was credited with the discovery of Pierre's Ruin complex. More importantly, the results of his work demonstrated that the road surfaces themselves could be documented archaeologically, independent of demonstrating consistent association with features.

In late summer and early fall of 1976, a survey crew from the Chaco Center completed an inventory survey of approximately 3 square km in the Pierre's Ruin vicinity (Powers, Gillespie and Lekson 1983). Twenty archaeological manifestations were recorded which dated to the early twelfth century. Three of the inventoried sites were massive constructions exhibiting the Bonito architectural style (see Figure 8-1). Two of them, LA 16508 and LA 16509, were found to be facing one another atop a lofty flat-topped mesita referred to as the "Acropolis." Powers (Powers, Gillespie and Lekson 1983) noted that the narrow summits of badland pinnacles were the preferred locations for construction within the survey area, and that every major elevation within 1 km of the Acropolis supported one or more small structures. Sites situated at the bases of the badland features were few in number; however, among these was the third and most massive of the Bonito Style constructions, LA 16515, itself a unique architectural feature in the Eastern Anasazi world. It apparently utilized a precipitous and lofty badland pinnacle as a tower, the top of which was elaborated with a masonry "platform" or perhaps a "housed" kiva which has since entirely collapsed into rubble on the steep slopes of the natural feature. Notably, atop this lofty spire is a hearth where many large fires have been built and the visibility in all directions is excellent. Not surprisingly, the tip of this spire with its much-used hearth marks the center of the projected alignment of the North Road. The massive Bonito Style structure (LA 16515) and the badland cone at its back have here been termed El Faro, "the Lighthouse."

Understandably, the vicinity of Pierre's became a focus for the study of prehistoric roads and road-related features in the Basin floor peripheral to Chaco Canyon.

Figure 8-1. Oblique aerial photograph showing Pierre's Ruin complex. A-Acropolis, Unit A; B-Acropolis, Unit B; C-Acropolis, Unit C; D-possible ramp; E-El Faro, lower roomblock; F-El Faro, pinnacle structure.

Unfortunately however, the alignment of the North Road did not image well in the immediate vicinity of the ruin (see Figure 8-2). A search for features to verify the path of the projected roadway through the site area was attempted by BLM archaeologists C.R. Morrison and A.F. Lutonsky over a period of several years.

Two additional research efforts have been focused on the North Road. The Chaco Center staff was aware of many of the structures located along the North Road (Powers 1981: personal communication). One structure in particular (Halfway House) was singled out for additional documentation (Powers, Gillespie and Lekson 1983). In addition, analysis of aerial photography along the North Road alignment was performed by Leo Flynn (1981). Flynn was interested in methodological problems, particularly those related to the verification of the road as a prehistoric feature. He performed extensive photointerpretation along the North Road alignment and adjacent areas, which led him to conclude that more field work was necessary to confirm or refute the temporal affiliation of the road. He singled out a number of locations on the North Road, among them a portion of the road exhibiting historic reuse (LA 34297, known as "Leo's Hogan") (see Figure 5-7), and a possible causeway identified by C.R. Morrison as locations in need of additional investigation. Both were re-examined by Nials for this project (see Chapters 5 and 6).

To date several large surveys have been completed in the vicinity of the North Road. For a synthesis of the results of these surveys and a comparison of the archaeological environment of the Chaco Slope with that of the North Road corridor see Nelson and McAnany (1982).

Reconnaissance

The initial reconnaissance of the North Road began on the southern margin of Kutz Canyon at the BLM Angel Peak Overlook, where restrooms had been constructed roughly on the centerline of the prehistoric feature. This irony was offset by convenience, for the structures provided a means of sighting on the road alignment from the canyon bottom. Structural manifestations clearly in proximity to the projected alignment were noted, and scattered cultural materials were recorded in a tally fashion. Throughout this reconnaissance phase the crew attempted to use BLM 1973 ARS photography which had poor resolution, making ground location of the alignment very difficult. Unfortunately, the sage plains are an unforgiving landscape for those with poor imagery, as any irregularities in the surface are masked by the height and homogeneity of the sage cover. The surface of the Chaco Slope has changed dramatically in the decade since the imagery was taken, further complicating the problem of accurate ground location.

The North Road reconnaissance was certainly informative concerning the improbability of following a "bearing" through featureless terrain and returning after a day's work confident of having actually been on the prehistoric alignment. It can be considered a success primarily because it engendered a healthy respect for the problems the project would be faced with if roads were to be seriously documented archaeologically. Although it is not certain that all structures related to the road from Pierre's Ruin north to Kutz Canyon were encountered and documented during the reconnaissance phase of this project, nonetheless six structures (including Halfway House) were recorded and included in the road-site analysis. The following is a list of these sites, their structural type (refer to Chapter 9), and their distance from Pueblo Alto (see also Figure 8-3):

Kin Indian Ruin (LA 40402), Great House, 5.1 km; Pierre's Ruin Group, Great House, 18.9 km, Burned Jacal (LA 34304), Herradura, 30.1 km, Halfway House (LA 15191), Zambullida, 35.3 km; Gallegos Crossing (LA 34303), Avanzada, 37.9 km; Angel Peak Overlook Group, Avanzada, 46.4 km; (LA 34305-7).

Intensive Inventory

Following reconnaissance of the North Road from Kutz Canyon to the Escavada Wash, a survey corridor 400 m (ca. one-quarter mile) wide was delineated from the northern margin of the Escavada Wash to the Pierre's Ruin complex, 15.2 km (9.5 miles) to the north (see Figure 8-4, back pocket). The survey corridor was centered on the alignment of the North Road as imaged by Obenauf (Obenauf 1980a). One section was excluded from the survey area because it had been previously inventoried (Kemrer 1982). Otherwise the entire designated corridor was intensively surveyed for cultural material.

A summary of sites recorded which were affiliated with the North Road alignment is presented in Table 8-1. Paleo-Indian remains consisted of the mid-section of a Plainview/Midland lance point (ca. 9000-8000 BC) noted in the road alignment about .5 km north of LA 34304, and IO No. 80, a base from a possible Paleo-Indian lance point. Although Archaic remains (ca. 7000 BC-400 AD) are reputedly common on the Chaco Slope, direct evidence of Archaic use of the corridor based on diagnostic materials is minimal. Two site locations (LA 34273 and LA 34280) probably represent late Archaic processing areas based on the presence of fire-cracked rock, basin metates, and hammering and chopping implements. Broad corner-notched lance points from LA 34280 and IO No. 27 suggest a date to the late Archaic period.

Ten lithic sites of unknown cultural and temporal affiliation were documented within the corridor (see Table 9-9) along with 39 isolated lithic artifacts or limited lithic

Figure 8-2. Low sun angle aerial photograph of Pierre's Ruin, showing the relationship of the visible and projected road alignments to major structural sites. A-parallel road segments entering the Pierre's Ruin complex, showing the easternmost segment diverging slightly in the direction of the Acropolis ramp; B-the possible ramp ascending the Acropolis; C-large mesa remnant known as the Acropolis; D-El Faro, lower roomblock; E-El Faro, pinnacle structure.

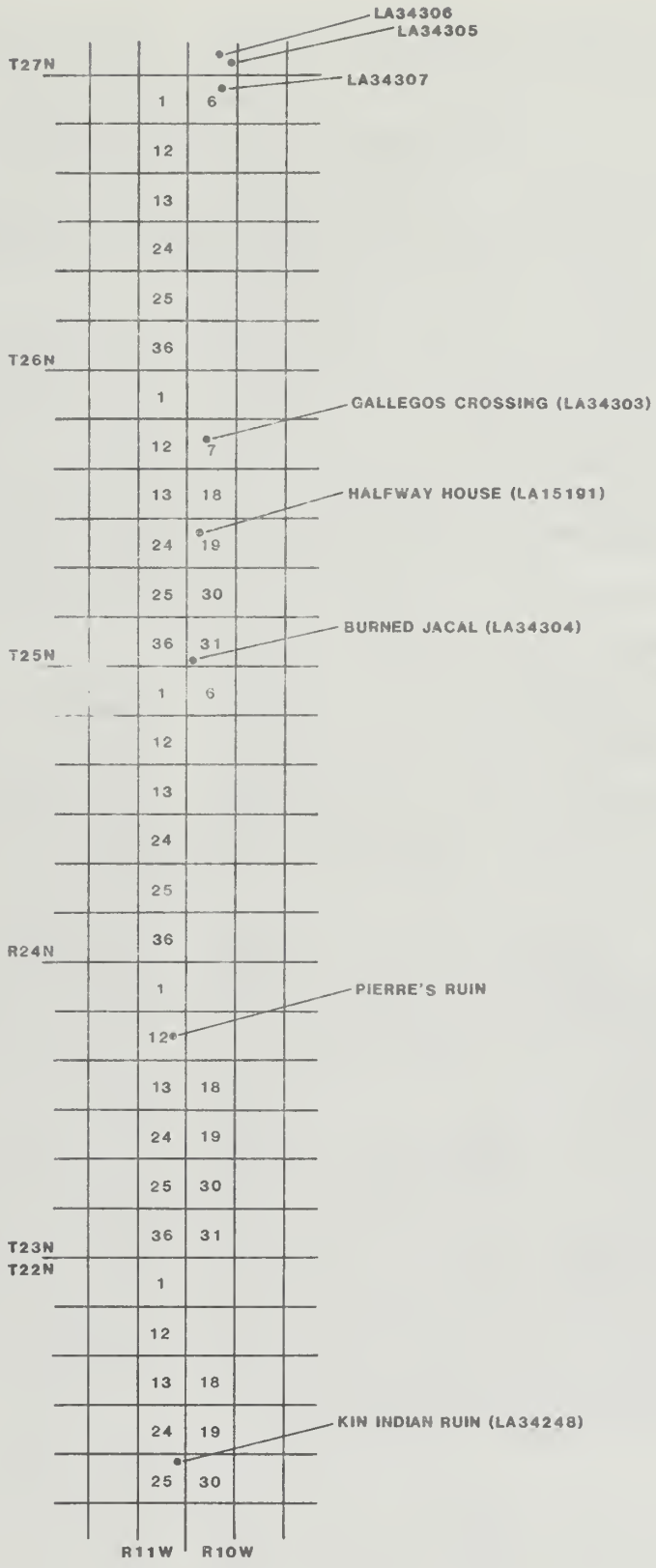


FIGURE 8-3 Schematic diagram showing relationship of major structural sites located along the alignment of the North Road.

TABLE 8-1

NUMBER OF COMPONENTS BY ROAD AFFILIATION AND SITE TYPE

Site Type	North Road	Penasco Blanco to Ahshislepah Road	South Road	Other Roads	Total
Zambullida	1	1	0	1	3
Herradura	0	0	1	3	4
Bonito Phase	4	0	4	6	14
Lithic Direct	0	0	0	0	0
Lithic-Ceramic Direct	2	0	0	0	2
Ceramic-Lithic Direct	9	1	1	0	11
Ceramic Direct	3	4	2	0	9
Roomblock	0	0	7	0	7
Lithic Proximity	12	2	0	0	14
Lithic-Ceramic Proximity	6	0	0	0	6
Ceramic-Lithic Proximity	9	0	2	0	11
Ceramic Proximity	5	1	5	0	11
Avanzada	8	0	0	1	9
Other Prehistoric	0	2	2	0	4
Visible Swales without Material Culture	11	6	5	0	22
Prehistoric Components	70	17	29	11	127
Total Ceramics	1,548	305	2,280	1,150	5,283
Historic	14	10	7	0	31
Visible Swales with Material Culture	5	5	4	0	14
Total Visible Swales	16	11	9	0	36
Transects	0	6	0	0	6
Indeterminate Age	1	2	8	0	11

scatters. Fire-cracked rock was present in five instances and ground stone was present in four instances. All scatters were very limited in extent, with a moderate to low density of cultural material present. Actual material frequency ranged as high as 144 pieces. All lithic scatters occurred primarily on the southern exposed sandy slopes of mesa edges and on badland margins. Five lithic sites showed evidence of lithic reduction, two showed evidence of tool manufacture, and four showed evidence of plant processing.

Historic use of the Chaco Slope by Navajo and Anglo populations has been minimal and can be characterized primarily by manifestations resulting from a pastoral subsistence base. Fourteen historic components were documented in affiliation with the North Road corridor. Four components pre-date the 1930s, including three trash scatters and a hogan with adjacent corrals. Twenty-two Isolated Occurrences pre-dating the 1930s were recorded. These were primarily single incident trash dumps containing cans, bottles, etc. There is currently no occupation of the survey corridor in the form of domiciles or active camps.

Anasazi materials in the corridor date from around 1050 to 1125 AD (see Chapter 9). Forty-two manifestations were documented during the corridor survey and an additional five were recorded between Pierre's Ruin and Kutz Canyon during the reconnaissance survey. Structural remains within the corridor were virtually all either great houses in Direct Association with the alignment of the North Road (El Faro, the Acropolis, Kin Indian Ruin), or minor structures referred to here as Avanzadas elevated above the road in such a manner as to suggest Direct Association with it (see Figure 8-5). (For a discussion of types of road-site association, refer to Chapter 9.) The reader should note that the survey area terminated just south of Pierre's complex and that only selected locations within the community are treated herein.

Ceramic and Ceramic/Lithic scatters located directly within the alignment are generally composed uniformly of ceramics with no features and only a trace of lithic material present. In several instances these scatters are composed of dense ceramic material (several thousand pieces) confined to a 16-20 m corridor. These linear sites occur discontinuously but are primarily found in a 6.4 km area located 0.8 km south of Pierre's Ruin, where the North Road cuts a series of transverse dunes (see Figure 5-7). Curiously these scatters appear to be located between and not actually within the visible swales.

From the ground perspective, the most visible segments of the North Road system are from Pueblo Alto north to Kin Indian Ruin and the aforementioned segments of roadway south of Pierre's Ruin. Only a fraction (1.25 km) of the North Road is sufficiently intact to be amenable to documentation as a swale. In all, sixteen visible swales were recorded within the corridor, five with associated material culture and eleven without. The length of the swales ranged from 25 to 180 m, the width from 11 to 20 m. Depth was generally shallow, ranging from .14 to .85 m.

In summary, survey results indicate the North Road was constructed and used during the Anasazi period beginning no earlier than 1050 AD and terminating at or around the middle of the twelfth century. The road apparently traverses a landscape never intensively utilized by either historic or aboriginal populations. Virtually all Anasazi manifestations recorded within the corridor are assumed to be related in some way to the North Road. Indications are that permanent settlement of the area was not induced by construction of the road. Evidence for extensive camps or repeated use of the countryside, in the form of residential architecture, large amounts of fire-cracked rock, ground stone or formal processing tools was not found. In addition, no locations found within the corridor could definitely be linked to construction activity.

Pierre's Ruin

In August 1981, LA 16516 (possible masonry features and projected North Road alignment), LA 34301 (here referred to as Pierre's Causeway), and LA 16520 and LA 34298 (small rectangular rooms in elevated situations flanking the road alignment) were documented. This began investigations in the Pierre's Ruin area which ultimately resulted in tracking the path of the North Road alignment with some confidence to within 300 m of El Faro (see Figure 8-2).

In addition, a spur was identified which apparently ended in a formal ramp to the summit of the Acropolis. Access may have also been gained from the northern end of this mesita, as well as via a possible route which runs diagonally from near El Faro and intersects the ramp approximately midway up the slope where a small structure is located (LA 16522).

Projection of the alignment of swales and material scatters suggested that the road alignment enters or abuts El Faro from the south. Whether the road swings to the east or west (or both) of the El Faro pinnacle from there is not now known. The documentation of material from the low finger-like ridge radiating to the west of the El Faro pinnacle (LA 16516), the presumed route of the North Road, was largely inconclusive. For the road to have taken this particular route would have necessitated deviation from the projected alignment. It is more likely that the road passes or enters El Faro and continues up the narrow valley to the east.

Pierre's Ruin is situated on the southern margin of the break from the elevated Chaco Slope to the south and the mesa and badland headlands of the Denazin and Ahshislepah Washes to the north. A panorama of the Basin

Figure 8-5. The Avanzada is a simple masonry structure thought to be road-associated by virtue of its topographic position above the road. This example is located on the North Road near the Twin Angels Overlook. The road alignment, though not visible in this badland area, is projected directly below the structure.

Figure 8-6. View looking southeast showing the upper slickrock area of the stairway complex on the Penasco Blanco to Ahshislepah Road. Masonry and rock-cut stairs are located below the canyon edge beyond the figure (not visible in photo). Penasco Blanco Ruin is just beyond the right margin of the photo in the middle distance. A-Chaco Wash; B-Escavada Wash; C-stones on the west margin of the road.

north of Chaco can be seen from the Pierre's area, with the south rim of Chaco Canyon and the Lobo Mesa skyline to the south and the Gallegos-Chaco divide to the north (12 km) (Powers, Gillespie and Lekson 1983). From LA 34304, located on the crest of this divide to the north, the structures atop the Acropolis and a fire atop El Faro could no doubt have been seen. From the south, Pierre's could easily have been seen from the Windes' Shrine 20 SJ 706 above Marcia's Rincon on the south rim of Chaco Canyon, as well as from Pueblo Alto.

The relationship of structures within the Pierre's complex is not consistent with residential patterns known for Eastern Anasazi communities. Preference for the placement of structures on the summits of precipitous buttes and pinnacles, coupled with a high degree of architectural variability, suggest that Pierre's was constructed and utilized coeval with the North Road. Indeed, arrangement of the major structures within the complex acted to preserve the bearing of the road and to "receive" it into the community. It is thought that the Pierre's complex represents a constellation of special-function architecture whose location was probably predetermined during the engineering process for the North Road. Although the presence of residential architecture within the ruin group should not be ruled out, it does not appear as though the site maintained a residential population sufficiently large to be self-supporting. Evidence for a lengthy evolution of the Pierre's community is lacking and it is doubtful that the proximity of agriculturally productive soils determined its location.

Penasco Blanco to Ahshislepah Road

Introduction

The Penasco Blanco to Ahshislepah Road is a stretch of prehistoric roadway 5.2 km (3.25 miles) in length which originates at the base of the wall of the Chaco Canyon 347 degrees from Penasco Blanco Ruin (see Figure 4-6). Here the road makes a vertical ascent of 240' (73.2 m) over sheer cliffs and narrow talus-strewn benches. As the road approaches the lip of the mesa, a series of seven rock-cut and masonry stairways facilitates access to the mesa top (see Figures 8-6, A-5). From the margin of the mesa the roadway traverses the relatively level surface of the mesa top, making a sweeping arc at a general bearing of 330 degrees and dropping onto the slickrock bench of Arroyo de los Aguages, a minor lateral to the Ahshislepah Wash, at a distance 5.2 km from the mesa edge. At this point the road surface has dropped from a maximum of 6355' to 6180'.

As the road drops off the mesa cap, one immediately notes the remains of a Bonito Style ruin of the Zambullida type (see Chapter 9) documented here as "Los Aguages". At this location thousands of gallons of surface water can be found in a series of bedrock tanks.

From Los Aguages the road continues along the bearing of approximately 200 degrees following the slickrock bench for .7 km, then again crosses the sandy mesa cap for an additional .7 km to a point on the eastern margin of Ahshislepah Canyon where access was feasible. Here the road turns sharply to the west, following the natural contour of the slickrock, and drops 60' (18.5 m) down a series of probable cut-rock steps onto the masonry mound of LA 34324, a probable ramp constructed of fire-reddened sandstone. (The ramp is reduced to a low mound and detailed structural information was impossible to obtain.) Here the road apparently ends, 6.3 km distant from Penasco Blanco and 10.5 km distant from Pueblo Bonito. (Editor's Note: See Chapter 11.)

It was decided that a 5.2 km length of the Penasco Blanco to Ahshislepah Road should be documented to complement the surveys of the North and South Roads. This road was apparently "local" in the sense that it did not obviously articulate with a larger road system, and appeared to be unique in that it apparently did not terminate at a great house.

Previous Research

The Penasco Blanco to Ahshislepah Road was identified by Gordan Vivian who first spotted the feature on aerial imagery in 1964. He was able to follow the swale for 1.6 miles (2.6 km) along the mesa top and cautiously referred to the feature as a causeway. Vivian's son Gwinn, along with Robert Buettner, returned to the roadway in 1970-1971. Under the auspices of a National Science Foundation grant (Vivian and Buettner 1971) they recorded visible features, excavated segments of the stairway across from Penasco Blanco, and placed a trench across the road at LA 34308. These excavations revealed a bedrock base to the road, which had a width of 9.5 m, and a ridge or berm rising about 25 cm. The bedrock had been altered slightly to provide a flat roadbed (see Appendix A). Collections taken from the vicinity of the stairway are currently curated at the Southwest Cultural Resources Center, National Park Service, Albuquerque.

Vivian and Buettner assumed that the road entered Ahshislepah Canyon at the mouth of Arroyo de los Aguages, which caused them to miss the possible ramp. Discovery of this feature can be attributed to the Chaco Center Remote Sensing Project field crew in the summer of 1973 (Morrison 1973:34). Although portions of the Penasco Blanco to Ahshislepah Road had been visited and tested by other roads investigators, a thorough surface inventory of the feature had not been accomplished prior to the current study.

Reconnaissance

The seemingly premature termination of the Penasco Blanco to Ahshislepah Road at Ahshislepah Canyon has intrigued investigators since Gordan Vivian's time. (Editor's Note: See Chapter 11.) Attempts to project the alignment on the available imagery proved fruitless. Ground check of the canyon wall opposite the ramp yielded some Anasazi material but the results were otherwise inconclusive. Acting on the possibility that the road may have turned west down canyon to intersect with the Casa del Rio to Lake Valley Road in the vicinity of Casa del Rio, Mike Marshall, Dabney Ford and Cory Breternitz conducted a reconnaissance of the lower Ahshislepah Canyon in January, 1982. No features or site locations were encountered which would suggest that the road proceeded down the canyon (Michael Marshall 1982: personal communication). Additional reconnaissance of the projected alignment through a badland area several miles north of Ahshislepah Canyon also failed to produce results (Michael Marshall 1982: personal communication). The ultimate destination of this road remains a mystery.

Intensive Inventory

The defined survey area consisted of a 400 m (ca. one-quarter mile) wide corridor centered on the imaged alignment of the prehistoric road for a distance of 5.2 km (3.25 miles) (see Figure 8-7, back pocket). The total area surveyed was approximately one square mile (2.56 km^2).

A total of 17 prehistoric components were located on this road, including 2 undatable lithic sites (see Table 8-1). The Archaic period was sparsely represented. A plano-convex scraper (IO No. 32), identified as characteristic of the Jay Phase of the Archaic period by Dr. W. James Judge of the Chaco Center, was located in the sandy bottom of the Ahshislepah Wash. This represents the earliest artifactual evidence from the corridor, possibly dating to as early as 8000 BP. Two projectile points dating to the En Medio Phase (3000 to 1600 BP) of the Archaic period (Irwin-Williams 1973a: 9-11) were documented as IO No. 31 (a serrated point of white chert) and IO No. 22 (made of basalt). Although occasional pieces of lithic detritus were documented, formal tools were lacking and there was little evidence for intensive use of the area for camps, tool manufacturing or processing.

Anasazi remains dating from early Basketmaker times include glyphs of "broad shouldered men" on the rear wall of a rock shelter. There is a trace of Red Mesa and banded ceramic material (dating to ca. 930-1098 AD) in the vicinity of the Los Aguages tanks, but the greater mass of the ceramic sample recorded in the corridor dates to the early twelfth century.

Material associated with the road alignment was concentrated in the vicinity of Los Aguages, the ramp (LA 34324), and the stairway to the mesa top from Chaco Wash. Dense sherd scatters such as those documented for the North Road did not occur along the alignment of the Penasco Blanco to the Ahshislepah Road. However, documentation from a series of transects placed over a lengthy area of slickrock north and south of Los Aguages (see Appendix C) clearly demonstrated that densities of ceramic material could be utilized here to define the prehistoric alignment.

Ten historic components were located during the corridor survey. Four of them pre-dated the 1930s, two post-dated the 1930s, and four were undatable. Early Navajo use of the area is evidenced by a reduced structure (LA 34326) which may represent the remains of a storage feature or pen. A scatter of Navajo Grey ware dates this structure to as early as 1800 AD (Brugge 1981:4-5). There is abundant evidence for use of the Los Aguages tanks by the turn of the century, in the form of staves from water barrels, scraps of purpled glass and occasional hole-in-top cans. An apparent turn-of-the-century wagon road crosses Arroyo de los Aguages immediately south of the Los Aguages ruin, trending perpendicular to the prehistoric road. Survey of this road for a distance of 500 m resulted in the location of a hoop from a water barrel, a scrap of harness leather, a rusted tin suitcase, and a fragment of wagon spring. Although there are several families living along the Ahshislepah Wash today, there is little evidence that the tanks are used for watering livestock, and the area seems to be visited infrequently.

Eleven distinct segments of the Penasco Blanco to Ahshislepah Road were ground-visible at the time of the survey, six of which occurred without associated material culture. Swale length ranged from 10 to 250 m. Total length of ground visible segments approached 1.2 km, or 23 percent of the total alignment. These segments were primarily visible on the sandy mesa cap southeast of Los Aguages. Width of the swales ranged from 8 to 20 m, averaging 15 meters. Depth of visible swales ranged from .2 to .7 m.

South Road

Introduction

South and west of Chaco Canyon, the landscape undergoes a marked change from the high sage-covered plano and expanses of badland of the Chaco Slope to a seemingly endless panorama of cuestas and buttes rimming broad shallow valleys. Grass rather than sage predominates, increasing ground visibility. This southern quadrant shows evidence of use from late Basketmaker times at bounded locations along the margins of drainages. The dense dark Menefee sandstone, which exfoliates in the large uniform slabs

Figure 8-8. View of the Casa Patricio area, looking north along the South Road alignment. A-main alignment of the South Road projecting into South Gap; B-spur alignment to Upper Kin Klizhin; C-main alignment of the South Road leading south towards Bee Burrow; D-great kiva at Casa Patricio; E-historic corral.

Figure 8-9. View of the South Road, looking south-southwest across the southern Basin floor. A-La Mesita de la Junta; B-South Road alignment entering the area from Casa Patricio; C-angle change at topographic break; D-South Road alignment; E-location of Credibility Gap Herradura (note slight angle change at ridge crest); F-eroded area shown in Figure 5-1.

necessary for the fine-banded masonry of the great houses, is abundant. The broken character of the southern terrain provides a surreal and spectacular setting for the roads. Here the Anasazi monuments are literally swallowed up by the Basin floor, their presence masked by countless outcrops, pinnacles, rincons and shadows which mimic the dark mass of ruins. So effective is this natural camouflage that a structure of massive proportions only a few meters distant might easily go unnoticed.

Ultimately, the South Road system links Chaco Canyon with the Lobo Mesa-Dutton Plateau province, the western Red Mesa Valley, Zuni and possibly locations even further south. It is one of several arteries which are presumed to integrate Chaco with the southern and western periphery, the outer limits of which are now poorly defined but which are expected to exceed 160 km from Pueblo Bonito.

The two main components of the South Road have been labeled "South Gap to La Mesita de la Junta" and "La Mesita de la Junta to Kin Ya'a." Originating at South Gap, the South Road makes a sweeping curve over the foothills of South Mesa and assumes a bearing to Upper Kin Klizhin. It enters the Kin Klizhin Valley approximately 12.5 km from Pueblo Bonito and passes 200 m west of the tower kiva at Upper Kin Klizhin (LA 34205), articulating with that structure via a spur which is still visible at its southern terminus (see Figure 8-8). The South Road itself becomes visible as it jumps a mesa to the south near a large structural site and great kiva known as Casa Patricio, entering the area through a narrow break in the caprock now blocked by an historic corral (see Figure 8-8). It is again visible some 300 m further south, and is characterized by alternating swales and sherd scatters.

The South Gap to La Mesita de la Junta portion of the South Road ends with the attainment of the southern margin of the Kin Klizhin Valley. At this point is located a prominent, isolated sandstone pinnacle topped by a Windes' Shrine known as "La Mesita de la Junta" (LA 34230). (See Chapter 9 for a discussion of this site type.) This location affords a commanding view of the territory and horizon to the north and south. Here the bearing of the South Road changes to align with Kin Ya'a and Satan Pass (see Figure 8-9). This portion of the road, known as La Mesita de la Junta to Kin Ya'a, is a highly visible feature characterized by straight segments up to 1.6 km in length. An example of a unique type of road-related site known as the Herradura (also discussed in Chapter 9) is located just at the topographic break (see Figure 8-9). The great house of Bee Burrow is situated approximately midway between Upper Kin Klizhin and Kin Ya'a.

Previous Research

Intersecting with the South Road in the vicinity of the Kin Klizhin Valley is the "Rincon Road," so named because it passes through Marcia's Rincon in Fajada Gap. This road was originally imaged near the old CCC latrines and was first referred to as the "Latrine Road" by Morrison (1973:16). The survey area defined for the current project (see Figure 8-10, back pocket) was selected so as to monitor the convergence of these two roads.

The alignment of the Rincon Road was originally thought to intersect with the South Road at the Windes' Shrine of La Mesita de la Junta on the southern margin of the Kin Klizhin Valley. The initial identification of the Rincon Road alignment was based on projections and survey information dating to the Chaco Center Remote Sensing Project field work completed in the summer of 1973 (Morrison 1973:16-17; Appendix A). The RSP crew apparently approached the Kin Klizhin Valley from two directions, south and north. From the north they followed the projected alignment of the Rincon Road (Morrison 1973:16) out of Fajada Gap:

"The other road followed on the ground in the Fajada Gap is the 'Latrine' Road, PB:8E:1 [Rincon Road]. It gains its distinctive name from its path through an old latrine in the CCC Camp. It should be pointed out that the crew was forced to work from compass bearings in determining the route to walk. The road was not visible outside the boundary fence...a situation to be expected from the imagery....At the time, it was not known that the Latrine Road went any assignable place, though it was suspected that the ultimate destination might be Ya'a. A total of 7 miles was walked from Fajada Gap. As luck would have it, that particular trip ended in the small valley of the Upper Kin Klizhin Wash that this writer has been calling La Mesita de la Junta (La Mesita). It was apparent at the time, that La Mesita represented a population center and it was determined to return and survey the ruins and from there continue along the road, which reappears on the imagery there after the disappearance of the Latrine Road."

Following reconnaissance of the projected alignment of the Rincon Road, and after losing it in the Kin Klizhin Valley, the survey of the South Road (La Mesita de la Junta to Kin Ya'a segment) was initiated (Morrison 1973:17):

"The Ya'a to Chaco Road, as it turned out after Dr. Lyons and the writer reviewed the imagery, leads to the valley called La Mesita, the point which the Latrine Road survey was previously broken off. With that discovery, Dr. Lyons determined that the road survey return to the valley and continue to Ya'a from there."

Ultimately the RSP crew returned to the Kin Klizhin Valley which they referred to as La Mesita and recorded a series of sites on an alignment corresponding with the bearing which they had previously walked. This alignment was thought to connect with the La Mesita de la Junta to Kin Ya'a component (our

term) of the South Road at La Mesita de la Junta. Because the RSP field crew had not located the great kiva Casa Patricio, nor the tower kiva of Upper Kin Klizhin, we presume that survey of the South Road alignment from South Gap to la Mesita de la Junta was not undertaken in the summer of 1973 and that this section of road may not have been known to them at the time.

In June of 1977, Robert Powers of the Chaco Center walked the "South Road Alignment" shown on Remote Sensing Division base maps and discovered the ruins of Casa Patricio and Upper Kin Klizhin. In his field notes, Powers describes his discovery of Upper Kin Klizhin as follows:

"Wishing to cover as much ground as possible and check the area for road features, I continued upslope onto the mesa to the east (off the projected road route) and shortly saw a peculiar rocky mound. Upon reaching it, I found it was small outlier town, possibly rectangular in shape with 10-15 rooms and possibly two stories in height. The site in terms of size and shape is very reminescent of Kin Klizhin. Whether it has a tower kiva is difficult to tell" (Powers 1977).

Powers observed that Upper Kin Klizhin rested on a low ridge east of the South Gap to La Mesita de la Junta segment of the South Road. Using an imaged segment of roadway shown on the RSD base map, Powers then proposed an alternative alignment for the Rincon Road. The route suggested by Powers intersects the South Road alignment several hundred yards north of Casa Patricio, makes a slight change in angle at the valley bottom, skirts the ruin of Upper Kin Klizhin immediately below the plaza area to the southeast and makes an acute angle change on a bearing for Fajada Gap.

Intensive Inventory

The South and Rincon Road survey area was delineated so as to include the presumed intersection of the two roads in the vicinity of the Kin Klizhin Valley. In this area, material culture density is high, a situation very different from the North and Penasco Blanco to Ahshislepah Roads and contrasting significantly with the remainder of the South Road, which is similar in many respects to the two northern roads. Because of the high density of material, the strategy of recording isolated material pieces and lesser scatters could not be effectively pursued. Thus, figures for Isolated Occurrences are not quantitatively comparable with those given for the other two roads. Site dates discussed here are based on Marshall et al. (1979:257) (see Table 9-5).

Twenty-nine prehistoric and seven historic components were documented in the South Road corridor and vicinity (see Table 8-1). In addition, eight components of indeterminate age were recorded. Eight Isolated Occurrences were found, all of which were of Anasazi origin. No Paleo-Indian or Archaic remains were located.

Survey results from the Kin Klizhin Valley suggest an early occupation consisting of a dispersed settlement of unknown size. Overall residential patterning is not known; however, sites were found to be scattered along sandy ridges flanking laterals to the Kin Klizhin Wash. Individual structures tended to be small, and pit rooms were not visible from the surface. Anasazi occupation of the corridor apparently began during the early eighth century AD at the locations of LA 34209, an extremely dense sherd scatter in the vicinity of Casa Patricio, and LA 34223, a three-room slab structure. Seven locations including several small-camp processing areas appear to have been constructed or utilized at or around 850 AD. Most notable is the great kiva Casa Patricio, which was apparently constructed at this time.

By 950 AD most of the manifestations exhibiting early beginning dates were abandoned. Seven new locations were occupied, including three room blocks, one visible segment of roadway with associated ceramics, two ceramic scatters and La Mesita de la Junta. Sometime between 950 and 1000 AD, the Upper Kin Klizhin tower kiva replaced Casa Patricio as a community focus. Intensive use of Casa Patricio as a population center was apparently discontinued, although it may later have functioned as an aspect of the South Road. Sites showing beginning dates at 1000 AD include a roomblock, a road swale and associated ceramic scatter, and an Herradura (LA 34233) (see Chapter 9).

Eight site locations consisted of "backed" rooms constructed against low bedrock ledges. Orientation of these structures suggests that the road may have influenced their location. Material culture was so sparse that actual dates are unknown. An additional site of unknown age--a slab cyst--was obviously of Anasazi origin; however, no date could be assigned.

Seven site locations with historic components were documented in the South Road survey area. All historic manifestations apparently date to the late nineteenth and early twentieth century and consist of two hogans with masonry corrals, isolated masonry corrals and pens, simple "backed" rooms, petroglyphs and two segments of historic wagon road. Of particular interest is the segment of historic roadway (LA 34231) ascending the ridge south of La Mesita. This segment is clearly a constructed historic road which is partially coincident with the prehistoric road, although in the past it has been identified as evidence for prehistoric road construction.

Also noteworthy concerning the historic use of the valley is the presence of numerous quarries of the dense dark brown sandstone which outcrops frequently in this region. Because structural manifestations from the

historic period are few in number and ephemeral in nature, the ultimate destination of this quarried material is not known. The possibility exists that certain of these quarries may be prehistoric in age.

Nine documented components were prehistoric swales representing the South Road alignment. Four of these segments were associated with material culture (predominantly ceramics). The nine ground-visible segments totaled 1.6 km in length and ranged from 7 to 16 m in width. Depth of the segments ranged from .2 m to 1.5 m, the deepest being clearly scoured by erosion.

Rincon Road

The presumed location of a portion of the Rincon Road alignment was surveyed for this project (see Figure 8-10). Fourteen archaeological sites were documented near this projected alignment, consisting of either turn-of-the-century material or aspects of the Upper Kin Klizhin community. (Although not presented here, information on these sites is available at the Laboratory of Anthropology, Museum of New Mexico, Santa Fe.)

The absence of visible swales, the lack of evidence for construction, and the nature and distribution of located archaeological materials did not suggest verification of a prehistoric road within the Rincon Road survey corridor. It is now thought that the Rincon Road probably enters the Kin Klizhin Valley at another location, either near Upper Kin Klizhin as suggested by Powers, or perhaps farther to the east as indicated by a swale documented at LA 34223, 200 m northeast of Casa Patricio. It most likely intersects the South Road at Casa Patricio rather than at La Mesita de la Junta. In either case, future verification of the Rincon Road alignment will no doubt require higher quality imagery and intensive field documentation of the areas north and east of Upper Kin Klizhin.

Chapter Summary

The use of the corridor survey approach allowed the documentation of the cultural environment of the road alignments. For the North and Penasco Blanco to Ahshislepah Roads the majority of sites indicated a late Bonito Phase or early McElmo Phase occupation. The near total absence of other Anasazi sites in the corridor suggests that the roads were constructed in a cultural void, and that their construction did not signal the beginning of dispersed settlement throughout the area. For the most part, sites in close proximity to the road alignment appeared to be contemporaneous, perhaps related to road use or construction.

Spatial patterning in the majority of the South Road corridor was influenced by the presence of an early agricultural community in the survey area. The high density of material culture made it difficult to distinguish road-associated sites. Two sites, Casa Patricio and Upper Kin Klizhin, were directly articulated with the alignment yet showed evidence of early occupation. Although it was presumed that the agricultural community pre-dated road construction and use, this was difficult to establish in the field and required more intensive analysis of collected information (see Chapter 9).

CHAPTER 9

CHAPTER 9

ROAD VERIFICATION SUMMARY

The process of verification of an imaged alignment as a prehistoric road requires the consideration of a number of different types of evidence. Major steps in the verification process are depicted in Figure 9-1. Some of this evidence, such as the visibility of the road, the subsurface profile, the results of surficial rock counts, and standard archaeological inventory data, have been discussed previously. Two additional considerations will be introduced here. First, information pertaining to the density of sites and isolated artifacts recorded with respect to the prehistoric road alignment is presented. Evidence indicates that for the most part, higher densities of datable prehistoric components and Isolated Occurrences do indeed occur near the prehistoric alignment, generally within 100 m.

The remainder of the chapter addresses the question of road-association. For the purpose of this analysis, the terms "road-associated" and "road-related" have been defined to refer to any site, component or feature whose location, physical characteristics or function were substantially conditioned by or altered as a result of the existence of the prehistoric road alignment. Road-association is further defined as either a spatial relationship between the site (or internal features within the site) and the alignment, or as a unique set of site functions inferred from patterning in material culture (see Figure 9-1).

The results of this analysis of road-association should be considered tentative. Low site and artifact counts have introduced many possibilities for sampling error which should be taken into consideration. The primary utility of this material culture analysis is as an illustration of a possible approach to the complex questions of road-association.

A consideration of these issues completes the basic methodology proposed by this project for the "verification" of prehistoric roads. The phrase "methodology for verification" is used here to refer to a procedure for determining whether or not the road should be verified as a prehistoric feature, and does not imply that the actual verification of the road has already been completed or is a foregone conclusion. The methodology is structured as a series of procedures for accumulating and evaluating evidence, with a decision about verification being the final result.

Testing for Increased Densities of Cultural Material Near the Alignment

Variability in densities of historic and prehistoric components with respect to the road alignment can contribute to the understanding of both the origin of the road and the cultural environment of the road at the time of its construction and use. Information concerning component and artifact densities, and their relationship to the alignment is summarized in Table 9-1. For easier interpretation, it is also presented in graphic form for components (Figure 9-2) and for Isolated Occurrences (Figure 9-3). Separate figures are presented for prehistoric components (excluding lithic scatters and visible swales without material culture), prehistoric lithic scatters, and pre-1930 historic components. Lithic scatters were presented separately from other types of prehistoric components because many of them are thought to date to the late Archaic period. In addition, since it was certain that the roads examined did not post-date 1930, only historic components pre-dating 1930 were considered.

For each road there is a distinct tendency for all prehistoric components but lithic scatters to occur in higher densities near the alignment. When all roads are considered as a group, 57 percent (35) of these components were found to occur in Direct Association with the alignment (0 m), and 92 percent (56) were found to occur within 100 m of the centerline (approximately 50 percent of the area surveyed). In contrast, no lithic scatters were found in Direct Association, although 75 percent (9) were found within 100 m. Similarly, no historic components were found in Direct Association, and only 66 percent (8) were found within 100 m. The slight correlation of historic components to the prehistoric alignment is considered spurioous, for the majority of these sites were found along historic roads intersecting the corridor. Four of these eight historic components consisted of only a few artifacts; the other four included a corral with no artifacts, an historic wagon road, a hogan associated with an historic road, and an early Navajo site.

Similar trends are apparent for Isolated Occurrences although the Direct Association category was not utilized in the analysis. Figures were not compiled for the South Road because of differences in recording techniques; only the North and Penasco Blanco to Ahshislepah Roads are considered here. For the two roads combined, 71 percent of the ceramic Occurrences (36) and 88 percent of the recorded artifacts (220) occurred within 100 m of the alignment. In contrast, only 47 percent of the lithic Occurrences (22), 37 percent of the lithic artifacts (74) and 57 percent of the historic Occurrences (20) were located within 100 m of the alignment.

These results clearly indicate a correlation between prehistoric non-lithic components and Isolated Occurrences, and the prehistoric alignment. The weak correlation noted between historic components and the alignment is not considered significant because 1) the

FIGURE 9-1 STEPS IN THE VERIFICATION OF A ROAD AS A PREHISTORIC FEATURE

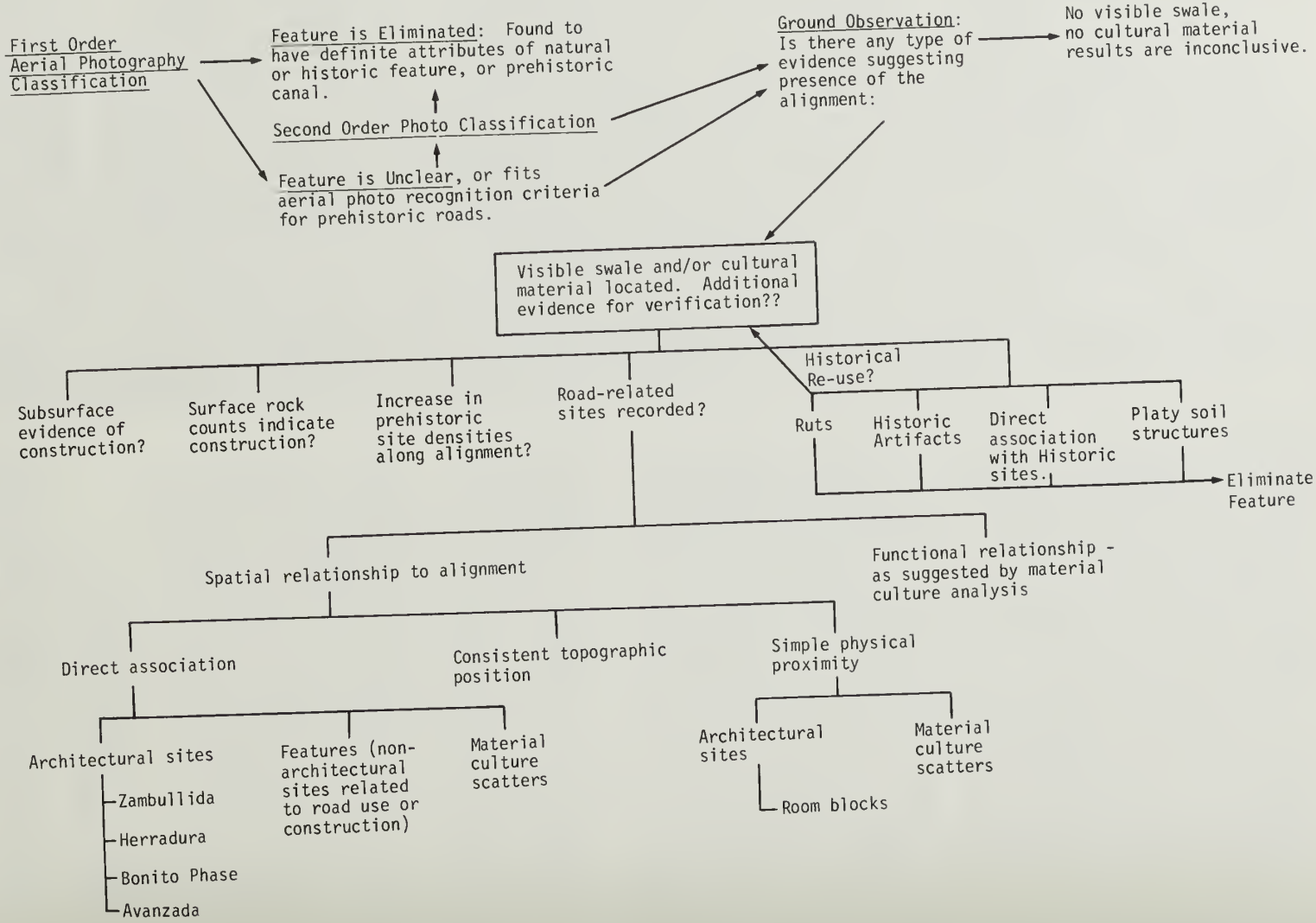

First Order Aerial Photography Classification
Feature is Eliminated: Found to have definite attributes of natural or historic feature, or prehistoric canal.
Second Order Photo Classification
Feature is Unclear, or fits aerial photo recognition criteria for prehistoric roads.
Ground Observation: Is there any type of evidence suggesting presence of the alignment:
No visible swale, no cultural material results are inconclusive.
Visible swale and/or cultural material located. Additional evidence for verification??
Subsurface evidence of construction?
Surface rock counts indicate construction?
Increase in prehistoric site densities along alignment?
Road-related sites recorded?
Historical Re-use?
Ruts
Historic Artifacts
Direct association with Historic sites.
Platy soil structures
Eliminate Feature
Spatial relationship to alignment
Functional relationship - as suggested by material culture analysis
Direct association
Consistent topographic position
Simple physical proximity
Architectural sites
Zambullida
Herradura
Bonito Phase
Avanzada
Features (non-architectural sites related to road use or construction)
Material culture scatters
Architectural sites
Room blocks
Material culture scatters

TABLE 9-1

COMPONENT AND ARTIFACT COUNTS IN RELATIONSHIP TO ROAD ALIGNMENT

	Meters from Center of Alignment						
	0	1-50	51-100	101-150	151-200	Corridor Total	201 +
Datable Components							
Prehistoric (Except Lithic Scatters[a/])							
North Road	22	6	5		2		5
Penasco Blanco to Ahshislepah Road	6	1			1		1
South Road	7	6	3	1	1		4
Total	35 (57%)	13 (21%)	8 (13%)	1 (2%)	4 (7%)	61 (100%)	10
Lithic Scatters							
North Road		2	6	1	3		2
Penasco Blanco to Ahshislepah Road			1	1			
Total		2 (17%)	7 (58%)	2 (17%)	3 (25%)	12 (100%)	2
Pre-1930 Historic[b/]							
North Road		3			1		
Penasco Blanco to Ahshislepah Road		2	1		1		
South Road		2		2			2
Total		7 (58%)	1 (8%)	2 (17%)	2 (17%)	12 (100%)	2
Isolated Occurrences							
Ceramics							
North Road							
Occurrences		19	7	8	5		4
Sherds		174	25	16	10		8
Penasco Blanco to Ahshislepah Road							
Occurrences		8	2	1	1		1
Sherds		13	8	3	1		3
Total Occurrences		27 (53%)	9 (18%)	9 (18%)	6 (12%)	51 (100%)	5
Total Sherds		187 (75%)	33 (13%)	19 (8%)	11 (4%)	250 (100%)	11
Lithics							
North Road							
Occurrences		14	5	8	12		2
Lithics		32	28	57	60		7
Penasco Blanco to Ahshislepah Road							
Occurrences			3	1	4		
Lithics			14	1	8		
Total Lithics		14 (30%)	8 (17%)	9 (19%)	16 (34%)	47 (100%)	8
		32 (16%)	42 (21%)	58 (29%)	68 (34%)	200 (100%)	7
Historic Artifacts							
North Road		8	8	3	3		
Penasco Blanco to Ahshislepah Road		3	1	4	1		
Total		11 (35%)	9 (29%)	7 (23%)	4 (13%)	31 (100%)	0

Notes: [a/] Includes all sites which can be classified as prehistoric except lithic scatters and visible swales without material culture.
[b/] Does not include undatable historic sites.

Figure 9-2 GRAPHS SHOWING COMPONENT DENSITY IN RELATIONSHIP TO PREHISTORIC ROAD ALIGNMENTS

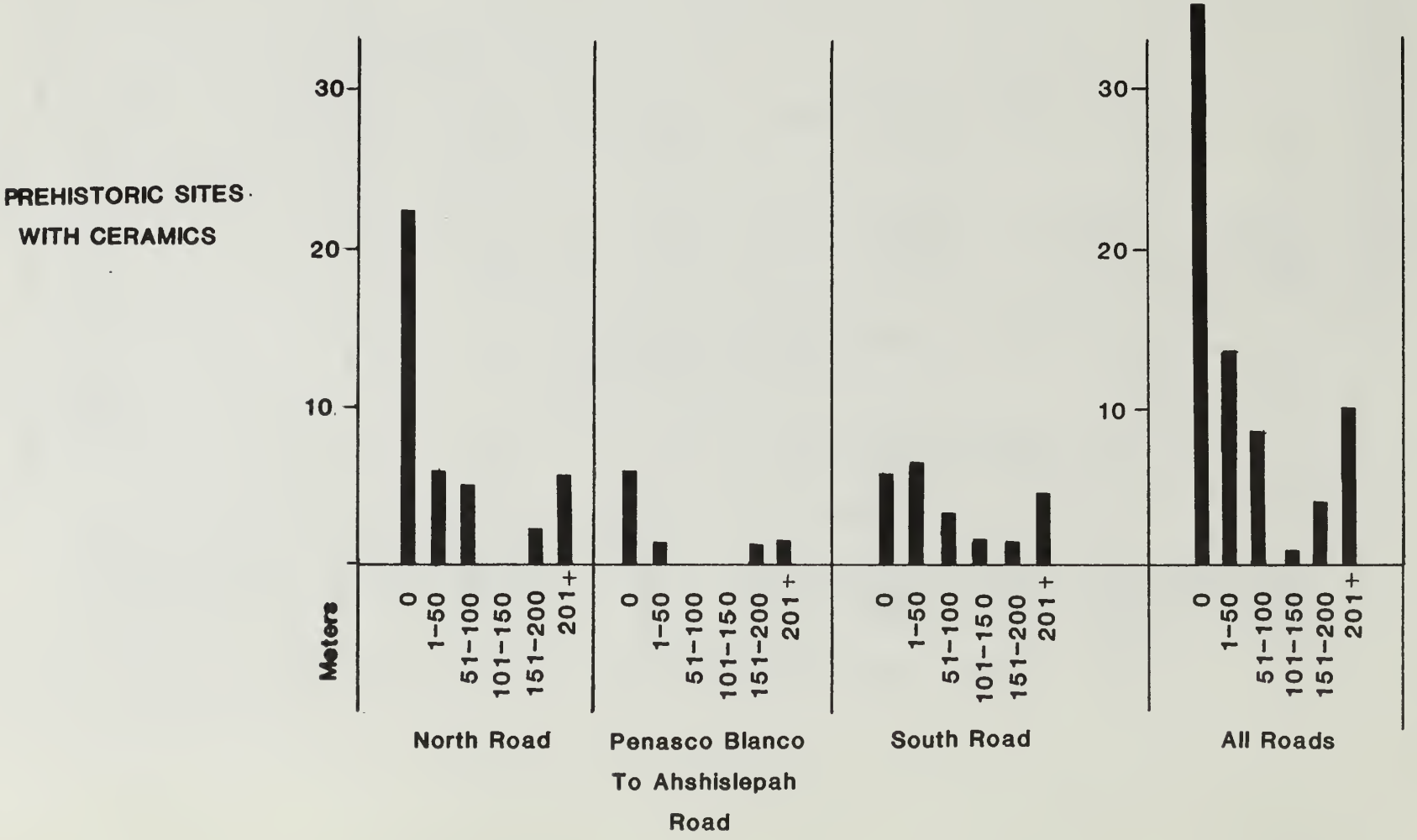


Figure 9-2, Page 2

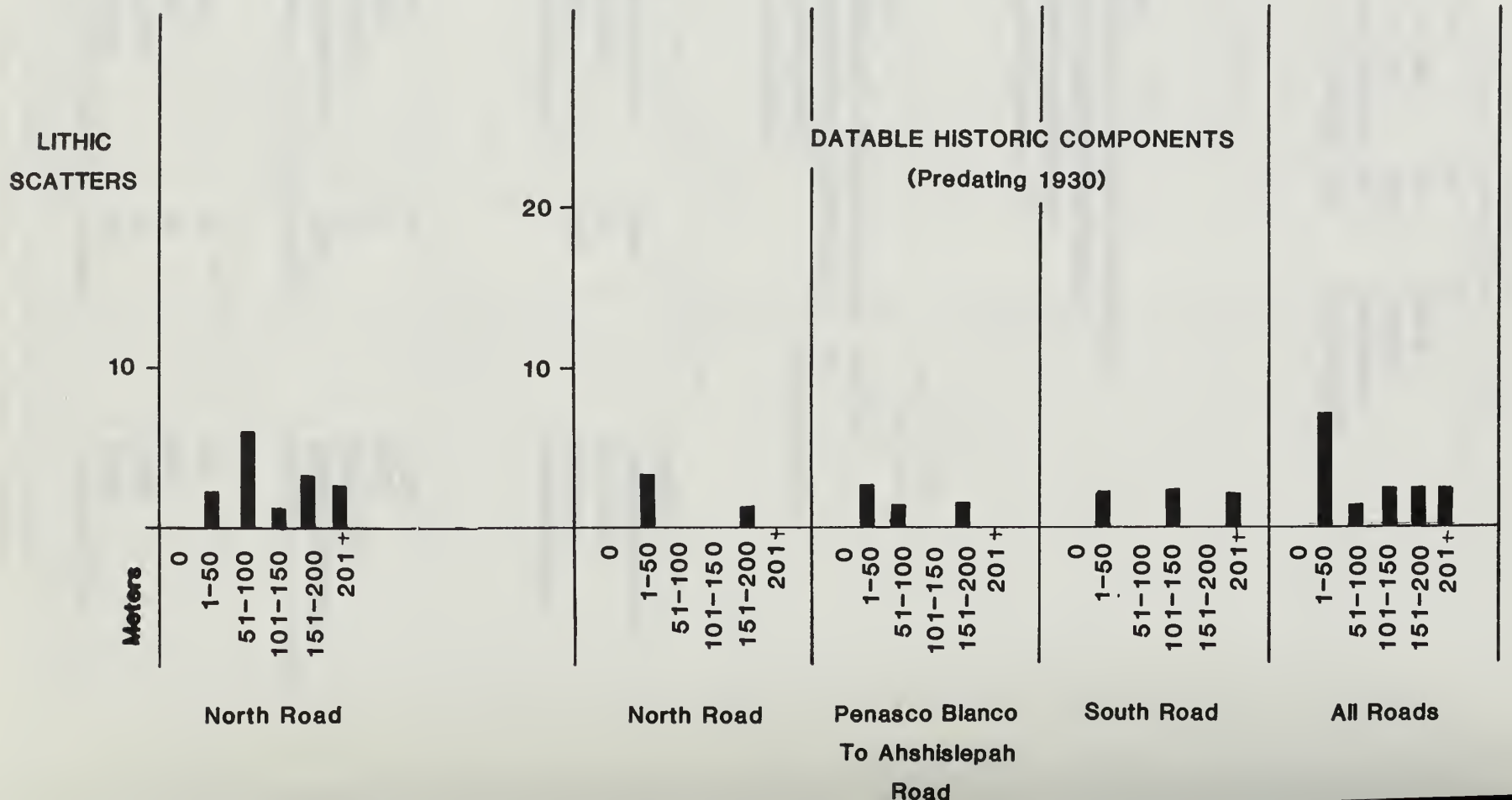
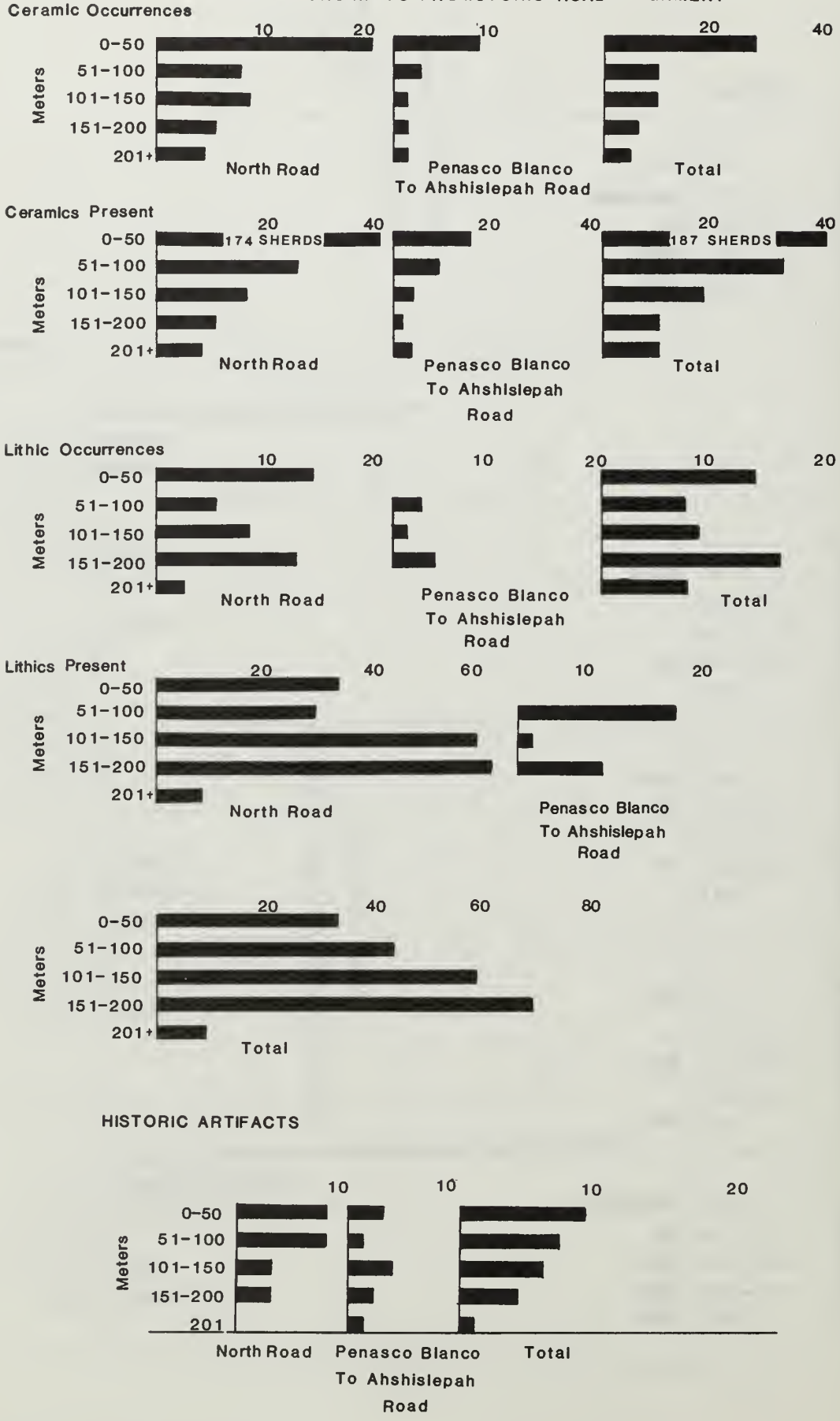


Figure 9-3 GRAPHS SHOWING DENSITY OF ISOLATED OCCURRENCES IN RELATIONSHIP TO PREHISTORIC ROAD ALIGNMENT



sample size is smaller (12 components total); 2) the majority of these components are either extremely small or are associated with historic roads adjacent to or within the prehistoric alignment; and 3) no historic components were found in Direct Association with the alignment. Lithic materials do not appear to increase significantly in density near the alignment. Taken together, this evidence is considered sufficient to suggest historic origin for the road systems under study.

A schematic representation of the suggested cultural environment of at least the North and Penasco Blanco to Ahshislepah Roads is shown in Figure 9-4A, where higher densities of contemporaneous prehistoric sites are found near the alignment (contemporaneity will be discussed later in this chapter). While higher densities support the interpretation of the road as a prehistoric feature, they do not provide sufficient information to demonstrate that the location or function of all of these sites has been conditioned by the road (i.e., that they are road-associated). This determination must be made on a site-specific basis, and requires careful consideration of structural, locational and material culture attributes. Analysis of these factors will be undertaken in the remainder of this chapter, and the issue of road-association of sites near the road alignment addressed more fully.

Road Association Defined in Terms of Spatial Relationships

Two main types of road association were recognized in the present study, spatial association and functional association (see Figure 9-1). Three patterns of spatial association are discussed below: Direct Association, Consistent Topographic Position, and Simple Physical Proximity. Direct Association occurs where the road swale or projected alignment, and site boundaries or aspects of features within sites, directly coincide, coterminate or articulate. Consistent Topographic Position refers to a recurring pattern in the position of certain types of sites with respect to the road alignment, with the sites generally occurring in elevated situations. Other types of sites recorded within the survey corridor are merely near the alignment (i.e., within the arbitrarily defined survey corridor) and are classified as being in Simple Physical Proximity to it.

It is assumed that sites in Direct Association and in Consistent Topographic Position with respect to the road alignment are road-associated (i.e., that their location, characteristics or function have been conditioned by the road). This assumption stems mainly from the failure of "coincidence" as an alternative explanation. Sites in Simple Physical Proximity do not, however, warrant this assumption. Although the previous section has shown that increased densities near the alignment do suggest road association for all sites within at least 100 m, there is nothing other than simple density to suggest that this is so. Not all sites in this category therefore are assumed to be road-associated.

Direct Association

A site can be considered road-associated if it exhibits a pattern of Direct Association with the road. Direct Association occurs where the road swale or projected alignment and site boundaries or aspects of features within sites directly coincide, coterminate or articulate. As used here, the term Direct Association implies a functional, temporal or morphological relationship between the road and the site in question. The basis for this assumption is the low probability that the road and site occupy their respective positions as the result of fortuitous circumstance.

The interpretation of Direct Association varies with the type of site in question:

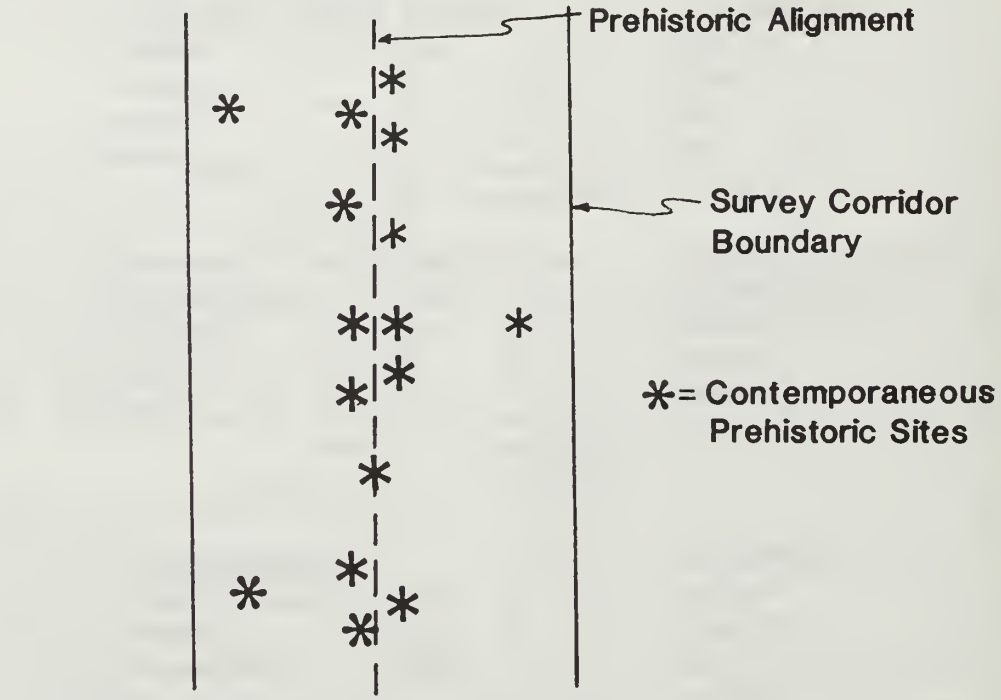
Architectural Sites. For architectural sites, Direct Association occurs where the road alignment projects directly into, or articulates with, architectural features, or where the location of architectural units suggests accommodation of the road alignment. This is seen where a road alignment passes directly through a formalized wall (as at Pueblo Alto) or immediately adjacent to architectural units (as at Poco and Kin Indian Ruin) (see Figure 9-5 for additional examples).

Sites Without Architecture but With Features. Many sites have been found containing features thought to relate specifically to the construction or use of the road. These types of features include ramps, stairs, hand-and-toe holds, causeways, curbs, walls, road markers, and others. They are also considered to be in Direct Association with the road. (For further discussion, refer to Chapter 6.)

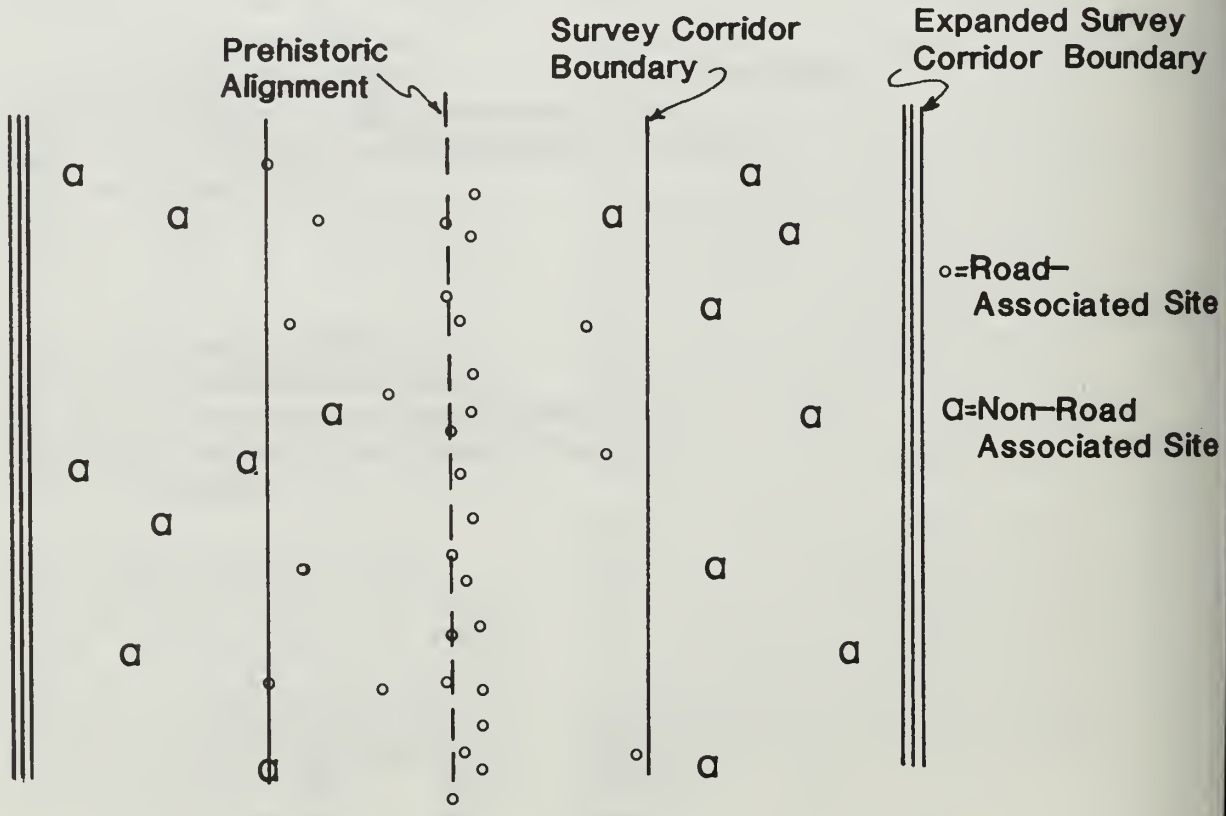
Included in this category are ground-visible segments or swales. A total of 36 visible segments were recorded during the project, 16 on the North Road, 11 on the Penasco Blanco to Ahshislepah Road, and 9 on the South Road. Of the 36 total segments, 14 had associated material culture. These were analyzed together with non-swale material culture scatters, under the category of Direct Association.

Sites Without Architecture and Without Features (Artifactual Scatters). Two main criteria were evaluated to decide whether an artifactual scatter was to be considered in Direct Association with the prehistoric road alignment. First, it had to be, for the most part, within the visible or projected road alignment. Second, the boundaries of the scatter had to coincide at least roughly with the boundaries of the swale or projected alignment. The overall

Figure 9-4 SCHEMATIC ILLUSTRATION OF SITE DENSITIES WITH RESPECT TO PREHISTORIC ALIGNMENT

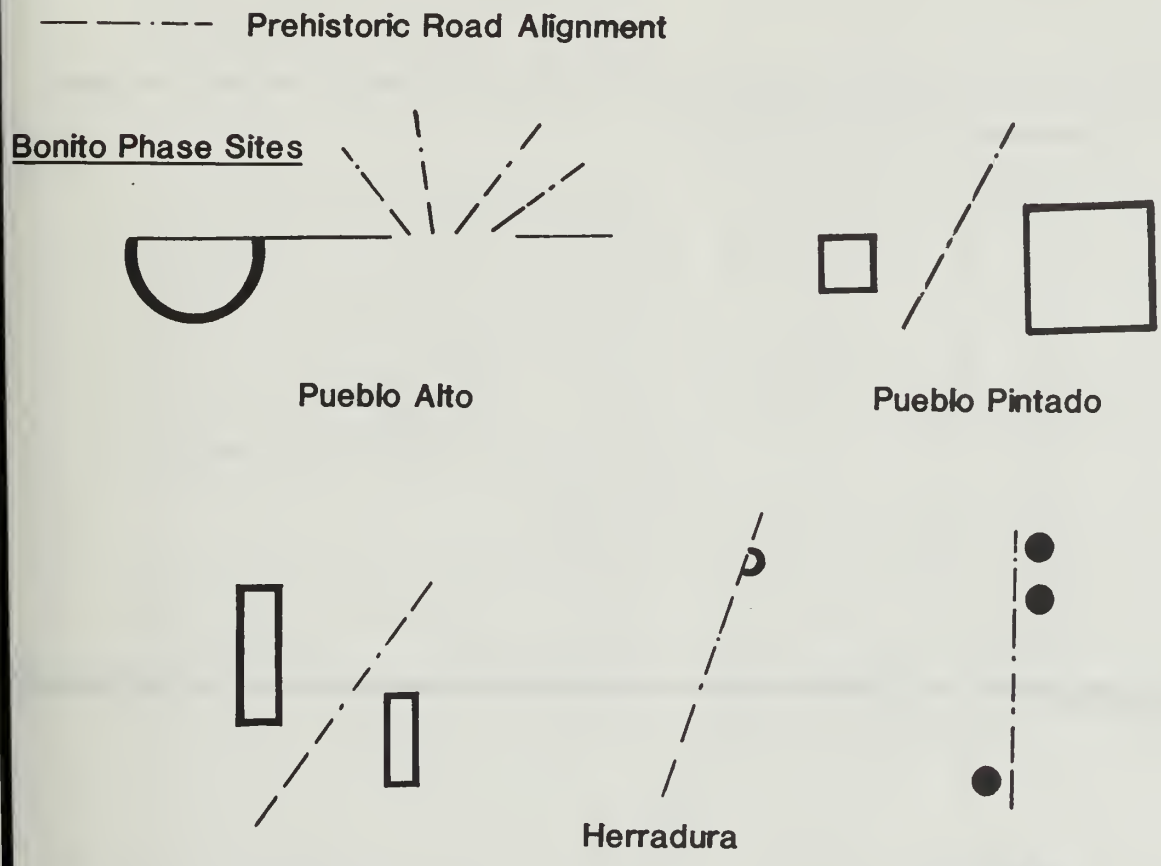


A – Increased density of contemporaneous sites near the alignment.



B – Increased density of functionally unique contemporaneous road–associated sites near alignment.

Figure 9-5 PLAN VIEW SCHEMATIC ILLUSTRATION OF TYPES OF DIRECT ARTICULATION BETWEEN ROAD ALIGNMENT AND STRUCTURAL SITES



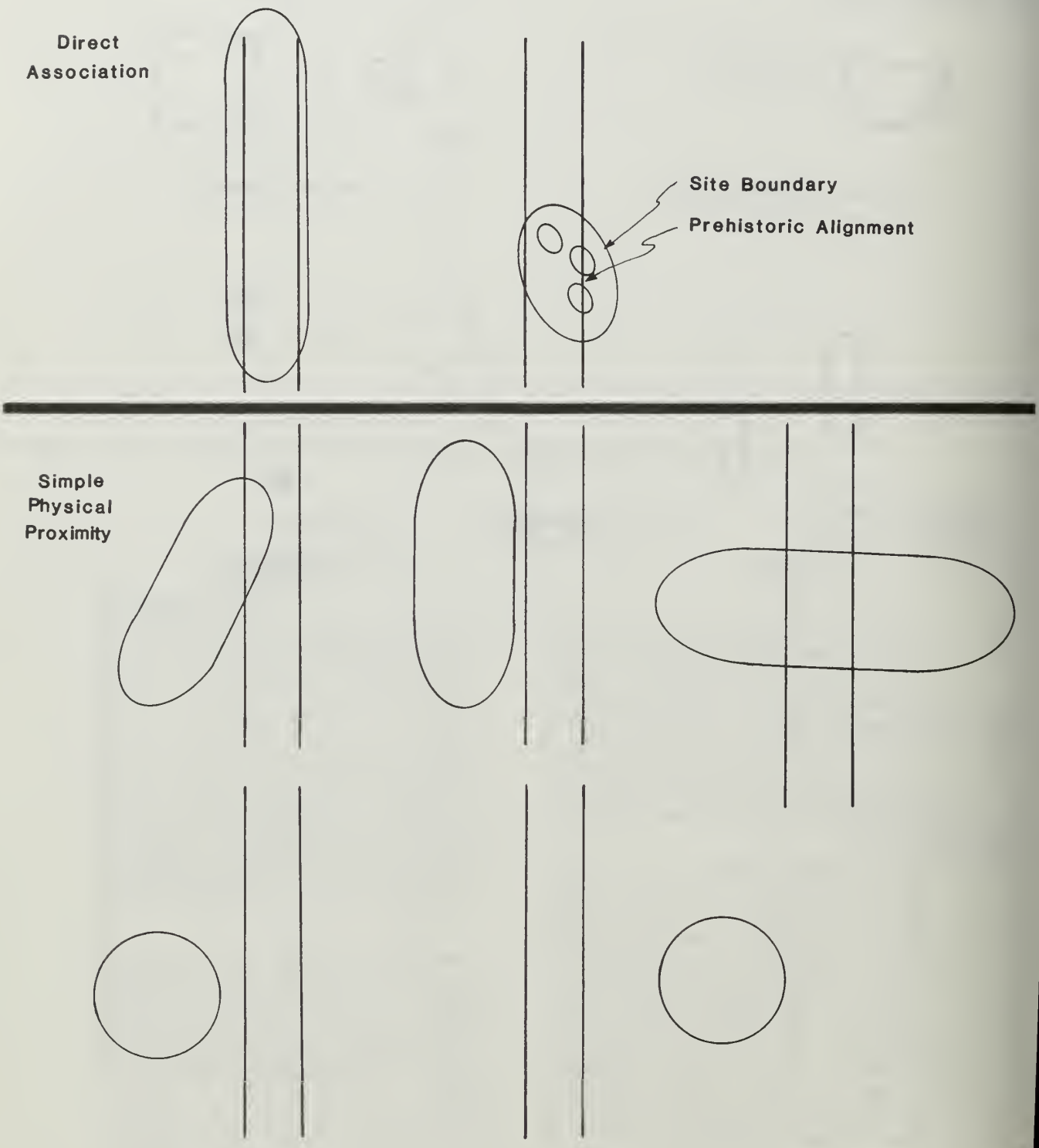
site configuration had to be more or less "cigar-shaped" (elongate) with the long axis of the scatter paralleling the axis of the road. Sites which contained sporadic concentrations of material which were aligned with the road axis were also considered to be in Direct Association. A site which was near or overlapping the road alignment, but which did not exhibit coincident boundaries was considered to be in Simple Physical Proximity. Schematic examples of these types of road-site relationships are presented in Figure 9-6.

This technique imposed a bias against including smaller sites in the Direct Association category. In many cases, small sites were located very close to the centerline but did not have the requisite elongate configuration and their boundaries did not coincide with the boundaries of the prehistoric alignment. They were not included in the Direct Association category, although it was often easy enough to explain these occurrences as the result of erosion-caused modification of primary artifactual distribution. This restrictive definition was used to avoid as much as possible including any sites fortuitously close to the road which might mask the presence of "road-associated" patterning should it appear in later material culture analysis.

Artifactual scatters in Direct Association with the alignment were divided into four major groups depending on the type of artifacts present. Lithic sites were defined as having virtually all lithics. Ceramic sites were defined as having virtually all ceramics. Lithic/Ceramic sites had a preponderance of lithics, while Ceramic/Lithic sites had a preponderance of ceramics. This categorization is utilized in the analysis of material culture traits, found below. (For brevity's sake, an abbreviated reference system is sometimes used; Lithic sites in Direct Association are sometimes referred to as Lithic Direct sites, Lithic/Ceramic sites in Direct Association are referred to as Lithic/Ceramic Direct sites, etc.)

In many ways, the procedures for categorizing and analyzing material culture scatters represent a departure from traditional techniques. This stems mainly from the need to address the issue of road-association. Analysis had to be structured to reflect the two main factors under consideration: road association and site function. This is in contrast to the usual goal of analytical approaches, which are based on the assumption that environmental factors are "organizing" site variability, and which generally structure analysis around these factors.

Figure 9-6 SCHEMATIC ILLUSTRATION OF DIRECT ASSOCIATION AND SIMPLE PHYSICAL PROXIMITY FOR MATERIAL CULTURE SCATTERS



However site size, environment and artifactual density and variability were taken into account in the formation of functional site categories, and were controlled in the analysis and in the interpretation of analysis results.

Consistent Topographic Position

Sites in a Consistent Topographic Position with respect to the road were usually located in a position of topographic prominence. Certain types of structural sites were considered to fit within this category of association. These are described in more detail in the next section of this chapter, "Structural Site Type Descriptions." In general, two types of topographic positions were noted: local prominences such as mesitas, buttes, or badland pinnacles, where structures were elevated above the road surface, and major topographic breaks or changes in elevation where visibility from the road surface itself was a consideration.

In most cases, structural sites are located in areas having high visibility, but not necessarily in a position of high visibility from the road. These locations may have functioned merely to compliment an existing natural landmark. In some cases, the elevated position of a structure above the road caused the structure itself to be barely visible to the casual observer on the road. This matter is discussed further under the individual site type descriptions below.

Simple Physical Proximity

All corridor sites not in Direct Association or in a Consistent Topographic Position with respect to the alignment fell into the category of Simple Physical Proximity. The purpose of this category is to isolate sites whose spatial relationship to the road alignment may be fortuitous. Road association for these sites is not presumed, because of the possibility of their being located in the corridor by chance or coincidence.

Architectural sites considered to be in Simple Physical Proximity are discussed in the following section of this chapter. Artifactual scatters were divided into the same categories used for the analysis of Direct Association: Lithic Scatters, Lithic/Ceramic Scatters, Ceramic/Lithic Scatters and Ceramic Scatters. For convenience, the term Lithic Proximity is sometimes used to refer to a Lithic Scatter in Simple Physical Proximity, Lithic/Ceramic Proximity to refer to a Lithic/Ceramic scatter in Simple Physical Proximity, etc.

Structural Site Type Descriptions

The primary goal of this section is to provide a guide for the field archaeologist who eventually must face the task of identifying road-associated structural sites on the ground. This is apt to be difficult because, with the exception of great houses, the architecture discussed here is .. prominent or extensive, and is often very simple in nature. Structural variability is subtle and often difficult to recognize. The following site categories should be considered tentative. They are based on an extremely small sample, and it is entirely possible that as additional sites are recorded it will become necessary to alter the distinguishing criteria for these groups. To facilitate and encourage their continued comparison and re-evaluation, we have used a highly structured format in defining their characteristics.

The following discussion considers structural site categories which are thought to be road-associated, and those structural categories which are apt to be easily confused with road-associated architecture. Documentation of specific examples for most of the categories is presented in Appendix C.

The reader will note that some of the names of the structural site categories depart from convention. The terms Zambullida, Herradura and Avanzada may lack intrinsic meaning for many readers (although translations of these Spanish terms are included in the glossary). The purpose of these names, however, is to distinguish these site types from other similar categories. For example, the term Avanzada was used to refer to road-associated simple masonry structures, and to establish them as a unique subclass of commonplace masonry structures.

Zambullidas

Structural Form Criteria.

Structural Dimension. Walls are usually less than 1.5 m high, up to 1 m thick. Interior dimensions range from 3.5 to 9 m.

Structural Form. Sites vary in shape from rectangular to circular and can occur as contiguous structures. Non-contiguous units of variable orientation occur at the Poco Site and Los Aguages.

Masonry Style. Walls are usually less than 1.5 m high and up to 1 m in thickness. Masonry is typically Bonito Style, with massive compound to rubble-core masonry.

Construction Units. Simple, single story, single-unit construction is typical.

Mound Relief. Mound Relief is generally pronounced due to the "massive" nature of the Bonito Style masonry.

Formal Midden. Material culture in the vicinity of the Zambullida is generally less than that anticipated for great houses; formal midden deposition is not common.

Type of Road-Site Relationship.

Distance From Road. These sites are generally either articulated with, or are quite close to, the road alignment.

Elevation With Respect to Road. Zambullidas vary in this regard.

Position With Respect to Local Topography. In most instances, these structures are located at a major topographic break. In these situations high visibility from the road alignment seems to have been an important factor.

Site Configuration With Respect to Road Alignment. Sites are considered to be Directly Associated with the road. The location of architectural units generally accommodates the road alignment; Kimbeto Point is a possible exception.

Discussion.

Examples: Definition of the Zambullida as a structural class is based primarily on construction of massive masonry, general lack of formal midden debris, low formal walls, irregular structural forms, and consistent articulation with the road surface. To date, known Zambullidas include the Poco Site, Los Aguages, Kimbeto Point (see Figure 9-7), Unit C at Pierre's Ruin (see Figure 8-1), and Halfway House. A possible additional example is the structure described as Kin Bineola Shrine (LA 18713) by Marshall et al. (1979:64-5) which exhibits some structural characteristics in common with the "central masonry structure" at Poco (see Figure 9-8). LA 18713 is located above the "crescent-shaped" platform which marks the termination of "Avenida Kin Bineola" (Marshall et al. 1979:67-68).

Quadrants. Documented examples of this type of site are known only from the northwestern quadrant of the basin floor, with the possible exception of LA 18713, described above.

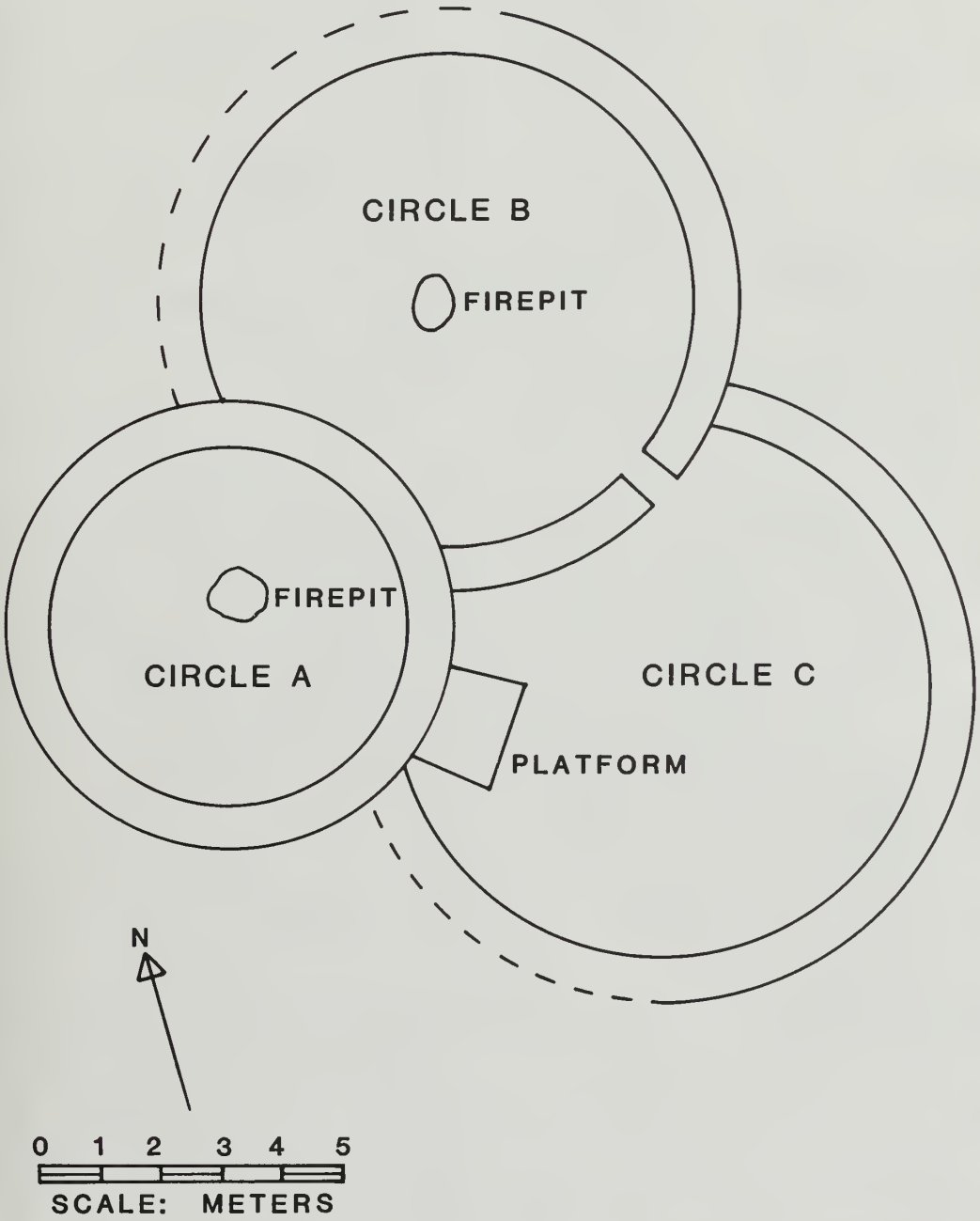
Comparison to Other Types of Sites. Compared with the great house, the Zambullida is a simpler architectural form containing few of the architectural elements common to the great house. Material culture in the vicinity of Zambullidas is generally less than that anticipated for great houses, and formal midden deposition is not common. Like great houses, Zambullidas are consistently road-related and are considered excellent predictors of the presence of prehistoric roads.

Interpretation of the Zambullida form should take into consideration the consistent late dates for the structures and association with the northern road systems. Structurally, the Zambullida might be considered a cross between the Herradura and the great house, being either an elaborate Herradura or a very simple great house. Locationally, the Zambullida is similar to the Herradura.

Figure 9-7. The structural mound of Kimbeto Point, seen from approximate location of projected road alignment.

FIGURE 9-8

POCO SITE
CENTRAL MASONRY STRUCTURE



BASE FROM DRAGER AND LYONS, 1981

Restriction of this structural type to the northern road systems suggests that both cultural and temporal factors have affected the evolution and functional diversification of the structural form. Although now considered an excellent predictor of roads, the validity of this class should be re-evaluated as more detailed information becomes available.

Herradura

Structural Form Criteria. The class of structure here termed the Herradura (Horseshoe) consists of a low masonry enclosure in Direct Association with the roadway (see Figure 9-9). Criteria for this site group are as follows:

Structural Dimension. Interior dimensions tend to range between 5 and 7 m for the long axis and 3.5 to 6 m for the short axis.

Structural Form. Structures are generally "C"-, "D"- or "horseshoe-" shaped. Structures sometimes occur singly although multiple features are often present.

Masonry Style. The quantity of rubble suggests that wall height rarely exceeded 1 m although it is possible that walls were extended by a jacal superstructure. Masonry style varies from simple to compound coursed masonry; the incorporation of upright slabs is common.

Construction Units. Herraduras generally occur as single units. (Editor's Note: During Phase II field work several multiple-unit locations were found.)

Mound Relief. Mound relief is low but pronounced. Because of their location these structures are often visible from a distance.

Formal Midden. No formal midden is present. Ceramic scatters are common although usually surficial in nature. The density of ceramics on the road surface increases in the vicinity of these features and the area of ceramic scatter commonly overlaps the road surface.

Type of Road-Site Relationship.

Distance From Road: Herraduras are always immediately adjacent to the prehistoric road alignment.

Elevation With Respect to Road. Generally these features are level with the road margin .

Position With Respect to Local Topography. Herraduras can be identified by their consistent topographic placement along the roads. All of the structures which meet the criteria of the Herradura occur in an elevated context in the vicinity of a major break in topography, such as a high ridge or the margin of a mesa. All are located in situations where they can be seen from some distance, in two directions along the alignment. Visibility perpendicular to the alignment is apparently not a consideration in location. Spacing of these features is apparently by topography, and varies considerably.

Configuration With Respect to Road Alignment. Herraduras commonly "open" directly onto the road alignment. Orientation is generally to the east however, a circumstance which sometimes overrides opening onto the road.

Discussion.

Examples. Documented examples have been recorded on the Casa del Rio to Lake Valley Road [LA 17222 (see Figure 9-10), LA 35415], the South Gap to Kin Bineola Road (LA 35417) and the La Mesita to Kin Ya'a portion of the South Road (LA 34233). Additional examples of structures meeting the criteria for Herraduras include several reported for other portions of the South Road, one on the Pueblo Pintado to Chaco Canyon Road, one possibility in the vicinity of Bee Burrow (Marshall et al. 1979) and one in the vicinity of Casamero (Gauthier et al. 1981:108; Windes 1978). On the North Road, LA 34304 might tentatively be considered an Herradura by virtue of its location on the margin of the Chaco-Gallegos divide, although no structural information is available for this site. (Editor's Note: See Chapter 11.)

Quadrants. Examples are known from all quadrants of the Basin.

Comparison to Other Types of Sites. Criteria for defining these structures for the most part do not overlap with the definitions provided by Thomas Windes (Windes 1978; Windes 1982: personal communication) for "Stone Circles," with the exception of projected wall height and location in areas of high visibility. It has not yet been ascertained whether an analogue to Windes' Stone Circles exists outside of the central Chaco Canyon area of the Basin. Features such as LA 18244 at Grey Hill Spring (Marshall et al. 1979:38-39; Windes 1978:63) may ultimately provide some insight into this problem. LA 18244, however, is an anomaly in that it neither fits the criteria for Windes' Stone Circles nor for Herraduras, yet overlaps both. Nevertheless, it appears as though there may be important functional as well as structural differences between Windes' Stone Circles and Herraduras.

Historically, Herraduras have often fallen in to the more general classification of "Round Roadside Attractions of the Shrine or Mega-Variety" (see below) (Morrison 1979), and are sometimes inappropriately referred to as "stone circles." Assimilation of this terminology into the archaeological vernacular has led to a considerable amount of confusion and uncertainty concerning the identification of this type of road-related feature.

In the field, Herraduras have often been confused with historic Navajo structures.

Figure 9-9. Herradura located on a bifurcation of the Casa del Rio to Lake Valley Road. A-Herradura structure; B-west fork of the road, leading to Lake Valley Ruin; C-northwest fork of the road, destination unknown; D-historic road which reuses prehistoric roadway.

Figure 9-10. Herradura structure located on the alignment of the Casa del Rio to Lake Valley Road (LA 17222).

However, the presence of prehistoric and the absence of historic material culture, their topographic placement in situations uncommon for hogans and other historic features, together with other recognition criteria, make it possible to readily distinguish the two.

Function. Although the presence of Herraduras is considered a reliable indicator of a prehistoric roadway, their real function is not presently known. They appear to have been hastily constructed, possibly incorporating both masonry and jacal elements. Material assemblages consist primarily of ceramic debris with no evidence for formal midden deposition, repeated camping, manufacturing, or processing activity. Although ephemeral in nature, the Herradura form is seldom found on the southern and western road systems, occurring only at major topographic breaks where visibility for some distance in at least two directions was possible (up to 7 km). Often these structures are spaced between great houses, though their locations are much more predictable than great house locations. However, actual spatial patterning, if any, has not been determined at present. Other than great houses, Herraduras are the most common feature marking the intersection of two prehistoric roads.

Great Houses (Bonito Style Structures)

The great house is perhaps the most conspicuous architectural form of the Eastern Anasazi. This structural type is defined by the presence of very standardized architectural elements which will be discussed below. Size of this structural type is highly variable. The consistent use of wall mass far beyond actual need has resulted in massive structures some of which are still standing after 800 years. Following collapse of the building, the rubble mass is sufficiently great to create a mound with "exaggerated" relief. Although not an architectural element per se, the mound provides an important recognition criterion for this type of structure.

The appearance of the great house in the Basin floor apparently took place during the early tenth century AD. This is based on dates of 900 AD derived from Penasco Blanco (Marshall et al. 1979:270), and of 943 AD from Kin Bineola (Bannister 1964:168-170; Bannister, Robinson and Warren 1970:20-21). There are basically three major building episodes on the Basin floor reflected in great house architectural styles. Following the initial appearance of the structural type in the 900's there is evidence for increase in building activity in the second half of

the eleventh century, and again in the first quarter of the twelfth century. There is a relatively dramatic change in the architectural form of the great house in the final or McElmo construction episode.

Structural Form Criteria

Wall Dimension and Configuration. Walls are consistently of rubble core or core-and-veneer construction, resulting in a massive wall .5 to 1 m in width. Ceiling height in these structures may be as high as 2.8 m (e.g., Pueblo Pintado), resulting in a tremendous mass of wall for structures with multiple stories. Tower kivas stood to a height of 12 m (e.g., Kin Ya'a), roughly equivalent to the elevation of the third story at Pueblo Pintado or Kin Bineola.

Masonry Style. Masonry considered to be "Bonito Style" varies somewhat from region to region. Earliest forms of Bonito Style masonry (ca. 900-1000 AD) consist of large slabs woven into a wall in a compound fashion. Often these slabs exhibit shaping by "scabbling" or flaking, and chinking is present. Classic Bonito Style masonry consists of a rubble-core wall composed of the dense dark sandstone common in the Basin floor. This sandstone exfoliates in even bedding planes and fractures so cleanly that stones can be incorporated into a wall in such a manner that a uniform surface can be obtained without further modification of the individual element. The wall surface is completed by forcing small spalls between the primary courses as "chinking." The uniformity of bedding planes represented by individual quarrying episodes resulted in the "banding" effect characteristic of the Classic Bonito Style masonry of the eleventh and twelfth centuries.

Bonito Style buildings which date to the later period of the Chaco sequence (post-1100 AD) are often constructed of soft sandstones shaped into uniform blocks by a process of pecking and grinding. These are incorporated into the walls in a manner similar to that described above. This masonry style is termed "McElmo" and is apparently confined to great house architecture. Masonry in the late great houses is not always pecked block however, and fine tabular masonry persists through the end of the continuum. There is some evidence to suggest that masonry elements for the great houses in Chaco Canyon may have been quarried outside the Canyon proper (e.g., Poco). There is no shortage of the dense sandstone so characteristic of the Classic great houses however, and the appearance of the pecked block could have represented the partial acceptance of a new style rather than exhaustion of the available sandstone, as has been suggested. McElmo style masonry corresponds with a major change in the basic plan of the great house form. Many if not all of the post-1100 AD great houses exhibit a McElmo layout, although the details have not been well defined to date.

Construction Units. Great houses incorporate certain architectural attributes in such a manner that they might be considered to be "modular" in nature. Vivian (1970:57-62) described the great house as "exhibiting a formal regularity in development and layout resulting in an ordered, compact and well defined structure marked by constant symmetry on a single axis." Great houses and great kivas exhibit a regularity throughout the Eastern Anasazi province (30,000 to 60,000 square miles) which strongly suggests standardized measurements for these structures. Although the discrete architectural elements in the great house may vary somewhat through time and within the different provinces of the system, certain characteristics such as massive masonry, central or elevated location in a community, great kivas, large rooms with high ceilings, and association with roads cross cut apparent cultural boundaries. Certain architectural elements of the great house are province-specific, such as the true tower kiva, which is known only from the southern quadrant of the Basin and the Red Mesa Valley. Other examples are the tri-wall, which is a northern architectural feature, and the Chuskan style of the great house which is a specifically western structural type. Marshall et al. (1979:15-16, 18) present a detailed description of attributes characteristic of the great house architectural tradition. The following discussion presents additional details.

Blocked-in or "housed" kivas are circular chambers constructed within large "rooms" incorporated into the roomblock. When these chambers are incorporated as second or third story constructions they are always built on fill. The roofs of these kivas form elevated platforms or "courtyards" often flanked by a tier of upper story rooms. The diameter of the housed kiva ranges from 5 to 9 m, with 7 m being most common.

Tower Kivas appear to be a special type of Bonito Style structure common only to the southern quadrant of the Eastern Anasazi system. Known examples include Upper Kin Klizhin, Kin Klizhin, Kin Ya'a, Haystack and Lower Greenlee. No examples of actual tower kivas are known from Chaco Canyon proper. The tower kiva architectural form consists of a series of 3 to 4 circular chambers stacked within a common rectangular housing or tower. The actual tower kiva module consists of the kiva housing flanked by a blocked-in surface kiva and attendant rooms which act as a buttress for the tower. The tower is characteristically incorporated into the central terrace of the structure and may or may not have stood higher than the supporting rooms. External dimensions of the tower housings are consistently 6.5 m, with the internal diameter of the kiva around 5 m. Height of the tower may vary. The tower at Kin Ya'a is estimated to have stood 12 m (Marshall et al. 1979:203). The tower at Kin

Klizhin is still standing to 9 m above ground surface (Marshall et al. 1979:70). The rubble mass of the tower at Upper Kin Klizhi suggests that it was similar, if not identical, to the tower at Kin Klizhin. Lower Greenlee is more completely reduced than Upper Kin Klizhin; consequently, reconstruction of the tower height is more problematical.

Ceramic dates for Upper Kin Klizhin and Lower Greenlee suggest that the tower kiva may have developed during the initial appearance of the great house in the Basin floor. Persistence of this architectural form is illustrated by Kin Ya'a and Kin Klizhin which date late in the Chaco sequence.

The evolution of the architectural form known as the great kiva or great sanctuary likely began in the Eastern Anasazi system during the sixth century AD, preceding the initial appearance of Bonito Style surface structures by approximately 4 centuries. The great kiva architectural form is evident throughout the Eastern Anasazi continuum and survives the abandonment of the San Juan Basin in the mid-twelfth century. Architectural detail varies from area to area through time; however, dimensions of these structures suggest standardized measurements (Marshall et al. 1979:265). Great kiva diameters range from 10 to 25 m, with the greater diameters tending to date earlier. Great kivas dating late in the Chaco sequence in the periphery are commonly 17.5 m in diameter, are only partially subterranean, and exhibit either a single large northern alcove (surface room) or multiple alcoves to the four cardinal directions. For detailed discussions of great kivas see Vivian and Reiter (1960) and Marshall et al. (1979).

An architectural element often incorporated into a Bonito Style building is a formal enclosed plaza. In Chaco Canyon proper, plazas are often ringed by single row of contiguous rooms. Often in lesser great houses of the periphery the plaza enclosures are less formal. The plaza usually contains fully subterranean kivas with diameters consistent with the blocked-in or housed kivas. In the largest great houses such as those in Chaco Canyon, the great kiva is contained in the plaza.

Various architectural manifestations in or near Chaco Canyon have been described as "platforms." Most if not all of these structures are related to the road system and are described in Chapter 6 and Appendix C of this report. Construction of a structure atop an artificially raised platform or the use of retaining walls and fill to create the illusion of a platform, appears to be characteristic of Bonito Style architecture. Examples of this situation can be seen at Aztec Ruin and perhaps at Section 8 Ruin. A very intriguing possibility for use of the platform as a dominant architectural element can be found at Lower Greenlee Ruin. In this instance the platform appears to be elevated to over 1 m in height and is contained within massive rubble-core walls. Unfortunately due to the advanced reduction of the rubble mound, exact configuration of the feature cannot be determined.

Perhaps one of the most distinguishing characteristics of the great house is the exaggerated relief of the rubble mound. This occurs even with moderate-sized structures due to the excessive mass of the construction.

The amount and character of the midden deposition associated with great house is highly variable. Generally speaking, the great houses are associated with multiple middens, which are often composed entirely of construction debris (spall middens), or construction debris mixed with cultural debris. In some instances, placement and relief of the midden is sufficiently formal as to suggest that it was an architectural aspect of the great houses (a type of earthwork). (Editor's Note: See Chapter 11.) Although the best example of this is the south midden at Pueblo Bonito which formalizes the entrance to that building (C.R. Morrison 1982: personal communication) the phenomenon is also visible at locations such as Haystack Ruin.

Type of Road-Site Relationship. As it becomes clear that some great houses were constructed to "accommodate" roads, and that the road system itself was engineered and constructed on a grand scale throughout the Eastern Anasazi system, it becomes more apparent that roads should be included as an aspect of Bonito Style architecture. Although some structures appear to have been constructed with respect to a single road system (e.g., Pierre's Ruin, Kin Indian Ruin), others, especially those constructed within major population centers, appear to represent the nexus of multiple road systems and exhibit the "water tank" trait of several roads converging on a single center. Great house architecture varies widely in topographic position, although these structures are most commonly located on valley margins midway between the valley floor and crest. Visibility is certainly a consideration in their location, as seen in great houses such as Pierre's Ruin, Kin Indian Ruin and Greenlee Ruin which are constructed on prominent landforms. However, there are exceptions to this rule (e.g., Upper Kin Klizhin, Lower Greenlee, Bee Burrow, Kin Bineola).

Roomblocks

Structural Form Criteria. Residential roomblocks were occasionally found within the survey corridors, although there was neither architectural nor topographic evidence of association with the prehistoric road. The criteria for the structural form of this class are as follows:

Wall Dimension. Wall thickness is less than 40 cm, the result of simple to compound masonry construction.

Wall Configuration. Sites generally consist of a simple roomblock of 1-5 contiguous rooms.

Masonry Style. Simple, coursed masonry is most common.

Construction Units. Generally contiguous rectangular rooms in a linear, "L"- or "U"- shaped block. Presence of a subterranean kiva would suggest domiciliary use.

Mound Relief. Mound relief is generally low, less than .75 m.

Formal Midden. Formal midden is usually present.

Type of Road-Site Relationship

Distance From Road. Distance from road is variable.

Elevation With Respect to Road. Roomblocks exhibit no consistent patterning in this regard.

Position With Respect to Local Topography. These structures are generally patterned with respect to agriculturally productive soils and are most commonly found flanking major drainages. There is no evidence of architectural accommodation or articulation with the roadway for any roomblock sites.

Discussion.

Examples. Seven roomblocks were recorded during the corridor survey; all were within the South Road corridor. They are: LA 34539, LA 34211, LA 34213, LA 34214, LA 34219, LA 34220, and LA 34223.

Quadrant. Although roomblocks were recorded only on the South Road during this survey, this type of architectural form is known to occur throughout the San Juan Basin.

Function. This class of structure appears to be a residential type of architecture, occasionally found in Simple Physical Proximity to a prehistoric road alignment but never demonstrably associated with it. None of these structures were found in isolation but occurred within and adjacent to population centers such as Pueblo Pintado and Upper Kin Klizhin. For the sites mentioned above, contemporaneity with the road alignment was not demonstrated.

Avanzadas

Structural Form Criteria. Avanzadas are small architectural sites whose relationship to prehistoric roads is inferred largely because of their Consistent Topographic Position with respect to the road alignments. The criteria for structural form for this class are as follows:

Wall Dimension. Walls are generally the width of one masonry element, about .3 m.

Structural Form. These features are all simple squared rectangular rooms. Orientation is variable.

Masonry Style. Architectural substance of these structures is minimal. Although simple coursed masonry might have been used, jacal might also have comprised a large portion of the structure.

Construction Units. Sites are all less than four rooms total.

Mound Relief. These sites are "ephemeral"in nature and mound relief is quite low.

Formal Midden. Associated material culture is very sparse, formal midden deposition is not present.

Type of Road-Site Relationship.

Distance From Road. Within the corridor this type of structure was surveys, consistently topographically situated within a short distance from the road. Pinnacles and promontories further from the road but within the corridor consistently did not have these kinds of features.

Elevation With Respect to Road. These structures are elevated above the road alignments.

Position With Respect to Local Topography. All of these structures are situated on elevated low buttes or badland pinnacles which are adjacent to and elevated somewhat above the road alignment (see Figure 8-5). Often these prominences rise above an otherwise level valley floor. Visibility of the road surface in the immediate vicinity is enhanced, but other types of visibility do not appear to have been a consideration in site location.

Configuration With Respect to Road Alignment. The road customarily passes below the structure; no specific architectural accommodation is apparent.

Discussion. Examples. The majority of known features which fit the description of elevated masonry structures are located on the North Road. LA 16520 is located to the north of Pierre's Ruin; LA 34298 is to the south; LA 34305 and LA 34306 flank the road alignment as it drops into Kutz Canyon. Additional examples on the North Road include LA 34303, LA 34304, LA 34307, LA 34213, and LA 34214. In a situation reminiscent of that at Pierre's, LA 35416 is located on the low butte several hundred meters west of Casa del Rio on the Casa del Rio to Lake Valley Road.

Quadrant. Examples of this type have been found in the northern and western quadrants.

Comparison to Other Types of Sites. Because of the ephemeral aspects of these architectural remains and the almost ubiquitous nature of single simple masonry rooms within the Anasazi world, road relationship cannot be inferred on the basis of structural characteristics alone. The primary distinguishing criterion for this category is Consistent Topographic Position with respect to the road.

Function. Judging from the sparsity of associated material culture, these sites were not the loci of prolonged domiciliary activity.

Windes' Stone Circles

Thomas Windes of the Southwest Cultural Resources Center, National Park Service, has described a type of architectural feature he refers to as "Stone Circles" (Windes 1977a, 1978). Criteria for recognition of Windes' Stone Circles are as follows:

Structural Form Criteria.

Structural Dimension. Structures range from 7 to 20 m across the short axis.

Structural Form. As their name implies, these features are oval to circular in shape. Continuity of the rubble mass suggests that openings through the enclosing walls were rare. Non-contiguous features such as isolated walls and rubble concentrations are common.

Masonry Style. Rubble mass extant at the time of documentation suggests that wall height rarely exceeded 1 m. Wall construction varies from rubble-core and massive compound to simple enclosures incorporating the use of upright slabs.

Formal Midden. No formal midden deposition is associated with Windes' Stone Circles. Ceramic and lithic associations with these structures are very minimal.

Other Characteristics. Bedrock basins are the only floor features seen in excavated examples; ground stone abraders are common.

Location. Virtually all structures which fit the restrictive criteria for Windes' Stone Circles occur on slickrock above great houses in Chaco Canyon. Although not presumed to be road-related, they may occur near access routes up the Canyon walls.

known Windes' Stone Circles are presumed to date late in the Chaco sequence. Criteria for recognition of Windes' Stone Circles are presented here in an attempt to eliminate confusion between these true Stone Circles described by Windes (1978) and other simple circular or semi-circular architectural forms such as the Herradura, Zambullida and Gateway Shrines (see below). All of these simple structures hold one or more attributes in common, but diverge widely in others. The

Comparison to Other Types of Sites. All Herradura, for example, could easily be confused with a Windes' Stone Circle if size, location and material culture association were not taken into consideration.

Windes' Shrines

Structural Form Criteria. A particular type of architectural feature herein called "Windes' Shrines" has been described in Hayes and Windes (1975), Windes (1977a, 1978), and Marshall et al. (1979). The term "shrine" reflects the location of these features in areas of high visibility and their consistent association with turquoise, azurite, malachite and shell artifacts (Hayes and Windes 1975). The criteria for this class are as follows:

Wall Dimension. Walls rarely exceed 1 m in height and are consistently .6 to .8 m in width.

Structural Form. Wall alignments form an "L"-, "J"-, "arch"-, or "comet"-shaped feature.

Masonry Style. Massive compound or rubble-core (Bonito Style) masonry is characteristic.

Construction Units. These structures generally occur singly.

Mound Relief. Because of the wall mass in these structures, known examples are not reduced and stand to their original height.

Formal Midden. No formal midden is present. Exotic artifacts of turquoise, azurite, malachite and shell are often found in association with these features.

Criteria for Road-Site Association.

Distance From Road. Distance from roads appears to be variable.

Elevation With Respect to Road. At this time, the issue of whether or not these features are road-related has not been decided. If they are, it is by virtue of Consistent Topographic Position and not Direct Association with the road alignment as defined here. When in the vicinity of a road alignment, Windes' Shrines are consistently detached from and elevated above the road surface (e.g., La Mesita de la Junta). Originally this shrine category was intended only for features located on major elevated landmarks and not otherwise corresponding with the alignments of prehistoric roads.

Position With Respect to Local Topography. These features are consistently located in elevated situations where visibility over long distances is possible. Most of the known structures of this type are located on the margin of Chaco Canyon proper.

Discussion.

Examples. Several examples of Windes'

Shrines have been located in the Chaco Canyon vicinity. LA 18708 and LA 18715 (Marshall et al. 1979:63-64) may well be associated with a portion of the road from Kin Bineola to Kin Ya'a.

Three possible structures meeting the criteria for Windes' Shrines were documented during the course of the Chaco Roads Project. Of the three, LA 34230 (La Mesita de la Junta) is most characteristic. LA 34235 (Provenience 1) is somewhat more reduced than is usual, but otherwise meets the criteria for location, configuration and masonry style.

Quadrant. As of this date, Windes' Shrines have been found only in central Chaco Canyon and areas to the south and west. Their presence Basin-wide is problematic.

Function. Because of their elevated position one would expect Windes' Shrines to function as "signal stations." However, there has been no evidence for repeated fires in the vicinity of these features (Windes 1982). If signalling were a consideration, then Windes' Shrines may have represented a communication option aside from that of the road corridors.

Gateway Shrines

Structural Form Criteria. Gateway Shrines do not conform to the criteria described for Windes' Stone Circles (Windes 1978) or Windes' Shrines (Hayes and Windes 1975). Gateway Shrines are structurally most similar to those structures found at Poco, which are classified here as Zambullidas. The criteria for recognition of this class of structure are as follows:

Structural Dimension. Structures are 5 to 7 m in diameter.

Structural Form. Structures are circular; "vents" or doorways may be located to the east or south.

Masonry Style. Wall height is approximately 1 m. Masonry is massive compound.

Construction Units. Structures occur singly in isolated contexts. Known structures are associated with massive Bonito Style cairns.

Mound Relief. Structures have not reduced and walls are standing to full height.

Formal Midden. There is no formal midden associated with these features. Material culture in association is extremely sparse.

Criteria for Road-Site Association.

Distance From Road. These features do not occur near known roads and are not thought to be directly road-associated.

Elevation With Respect to Road. Although these shrines are generally elevated, this is not considered to be a consequence of their relationship to a road alignment.

Position With Respect to Local Topography. There are two known examples of Gateway Shrines found on the cliffs overlooking the Chaco, both south and west of Penasco Blanco. These two structures, 29 SJ 1088 and Tse Nizhoni (LA 37676) are located on a mesa system flanking the Chaco Wash. Both structures are located in situations where access is very difficult and both are elevated in a prominent location.

It was known that 29 SJ 1088 was associated with a series of 13 large "Bonito Cairns" (see below) of rubble-core construction which, when viewed from below in the Padilla Well area, give the southern margin of the West Mesa a crenelated appearance. Investigations of the Chaco Road Project crew further west on the Chaco Wash revealed that similar cairns marked the mesa margin above the Chaco east of Pretty Rock (Tse Nizhoni). These large cairns were placed along the scarp of the mesa above the Chaco and may have served to enhance or mark that horizon as a kind of boundary of Chaco Canyon; hence the name Gateway Shrines.

Discussion.

Examples. This discussion is based on only two examples of this type of architecture. Because of the limited information available, it is impossible to determine the distribution of this structural type within the Eastern Anasazi world. Similar features have been noted, such as LA 1328, Feature 7 (Marshall et al. 1979:192) which overlooks the Malpais in much the same manner as do the two sites described above. An additional site is reported by James Bradford (1982: personal communication) to be located east of Las Ventanas, and two additional circular features located on a high elevated fin of sandstone in the Behind-the-Rocks area near Moab (Joyce Warner 1981: personal communication) may have a similar function.

Quadrant. The actual distribution of this architectural form is not presently known.

Comparison to Other Types of Sites. Unfortunately, the type of structure described here is very easily confused with Navajo hogans from the turn of the century.

The lack of historic material culture and the uncharacteristic topographic location should help distinguish Gateway Shrines from historic structures of this sort. Structural similarities to Zambullidas and Herraduras are obvious.

Function. It can be assumed with some certainty that these features are not habitations and may have served to announce or to elaborate portions of the landscape which were considered to be sacred or semi-sacred. Tse Nizhoni and 29 SJ 1088 may represent true shrines that are not "functionally" related to the road system and may be one aspect of a series of features that were constructed to delineate the boundary of the central Chaco Canyon area. Structures of similar form and dimension may have been used elsewhere in the Eastern Anasazi world.

Round Roadside Attractions

The term "Round Roadside Attraction" was coined by C.R. Morrison, following the Remote Sensing Project survey of prehistoric roads in 1973. The term has since enjoyed popular usage in reference to road-related features; it is included here for the purpose of clarification, since it has not been specifically defined in print. Morrison recognized two types of circular structures, referring to the smaller as the "minor variety" and to the larger as the "mega variety." The term "mega variety" or "shrine-like variety" refers to the structural form described here as Herradura. The term "minor variety" refers to a series of features smaller than the Herradura, 1 to 2 m in diameter, generally consisting of slab concentrations of various types. These structures may represent collapsed cairns, simple slab road markers, or small slab bins in the vicinity of the roadway.

The term Round Roadside Attraction might best be reserved for the features of the minor variety. Although few features of this type were positively identified during the corridor surveys, enough locations have been reported elsewhere (John Roney 1982: personal communication; Anthony Lutonsky 1982: personal communication) to warrant continued use of the term. Because of the potential confusion of Round Roadside Attractions with Windes' Stone Circles it is suggested that the term Herradura be used to refer to the road features of the larger variety.

Cairns and Other Similar Features

Cairns today are perhaps one of the most conspicuous cultural features of the San Juan Basin. Usually such features are not associated with diagnostic material culture which would allow determination of cultural or chronological affiliation. Because of their ephemeral nature, substantial reduction of the original construction is common. The issue of the relationship of this class of features to prehistoric roads has been and continues to be problematic (with some exceptions discussed in this report). Historic reuse and reconstruction of prehistoric cairns is known to be a common practice, as is modern construction of new cairns. This discussion focuses on the definition of different classes of cairns, to clarify the distinctions between them and other constructions as we understand them.

Historic cairns are quite numerous and often constructed in prominent positions in broken country. Construction techniques vary, but generally these features consist of simple stacked stone slabs. Elements can range from 20 x 10 x 5 cm to as large as 100 x 50 x 10 cm. Cairn height varies, but usually does not exceed 2 m; average diameter is .5 m. Descriptions of historic cairn construction can be found in Hayes (1981) and in Chapter 6.

Prehistoric cairns generally do not remain as visually prominent features. One exception is the type known as Bonito Cairns, found in association with what have been called Gateway Shrines (see above). These cairns are believed to be Bonito Style Anasazi by virtue of their mass (more than 1 m in diameter and several meters in height), construction (they exhibit rubble-core masonry), and situation (their location with respect to an obviously Anasazi ceremonial feature) (see Figure 9-11). Hayes (1981) presents a discussion of cairns found in and around Chaco Canyon, noting that simple cairns are often associated with what are here referred to as Windes' Stone Circles (Windes 1978). Unfortunately, it was not possible to assign cultural affiliation to these features.

Virtually no features that could be definitely described as cairns or the remains of cairns were documented during the course of the current project, with one exception--site number NM-G-63-98, originally recorded by the Chaco Roads survey crew at the request of the Navajo Tribal Bis'a'ani project. This site consisted of two relatively massive cairns, one of which was constructed of non-local sandstone. They were in an advanced state of reduction and appeared to flank a projected road alignment between the site of Bis'a'ani and Gallo Canyon. This site was later excavated by Marcia Donaldson (Donaldson and Ford 1982). Only the cairn constructed of the non-local sandstone was determined to be prehistoric in age. The amount of rubble suggested a relatively massive construction, however the results of trenching were inconclusive and the function of the cairns remains problematic.

Hayes found ten features which he described as slab boxes on the survey of Chaco Canyon from 1972 to 1974 (Hayes 1981). These features he presumed to be Anasazi in origin; they were approximately 1 m square and less than 1 m in height. Two of these slab boxes were found in elevated situations and one was near a spring. A single slab box was located

Figure 9-11. Large "Bonito Cairn" constructed of Bonito Style masonry, located on the edge of West Mesa overlooking the confluence of the Chaco and Escavada Washes.

during the course of this project, on a slick-rock bench near permanent water on the Penasco Blanco to Ahshislepah Road. Ethnographically, slab boxes have been demonstrated to be used as a repository for prayer sticks (Stevenson 1904). The function of the slab box in the vicinity of a prehistoric road is not currently known.

Slab boxes were the type of construction described by Morrison (1979) as Round Roadside Attractions of the minor variety, and the term has since been widely used to describe this feature. Two examples were encountered during the Remote Sensing Division 1973 field season (see Appendix A). One of them was located on the Sandspit Road below the Poco Site.

Because of problems in establishing temporal affiliation and patterned association, the utility of cairns or slab boxes as prehistoric road indicators is limited. At the present time, there is insufficient evidence to evaluate their function within the Chacoan system. (Editor's Note: Investigations during Phase II of this project located cairns positively associated with the Coyote Canyon Road.)

Signalling Stations

The subject of signalling and signalling stations within the Chacoan interaction sphere is a recurrent topic of discussion among Southwestern archaeologists. Although it is most often debated around the campfire, published mention of the phenomenon can be credited to Alden C. Hayes and Thomas Windes (Hayes and Windes 1975:143-156) following excavation of curious masonry features flanking Chaco Canyon, referred to in this report as Windes' Shrines. In conjunction with research directed at interpretation of Windes' Stone Circles (as discussed above) and Windes' Shrines, the Chaco Center during the decade of the 1970s endeavored to locate as many of these features as possible within and peripheral to the Basin floor. The proposition that Windes' Shrines were located in such a manner as to preserve line-of-sight was tested through a series of experiments known as "flare-ups." Flare-ups involved individuals lighting railroad flares at Shrine locations throughout the San Juan Basin at a pre-ordained time (during the night), and recording exactly what was visible from what. The results of the flare-ups demonstrated conclusively that the Shrines were, in fact, situated on the landscape in a position which resulted in the maintenance of line-of-sight between other Shrines and major great houses. Following demonstration that the features were topographically situated so as to preserve line-of-sight, the concept of signalling became an issue often touched upon in the literature (Lister and Lister 1981; Powers, Gillespie and Lekson 1983; Robertson 1981; Drager 1976).

Unfortunately, some misunderstanding as to the character of the proposed signalling system in the Basin has developed. Perhaps most important is the fact that neither Windes' Shrines nor Windes' Stone Circles show evidence for burning (Thomas Windes 1982: personal communication). This alone would rule out the possibility of large night fires or daytime smudge fires, although signalling with torches or selenite mirrors might be possible.

If Windes' Shrines and Windes' Stone Circles functioned as signalling locations, one might ask how such a signalling matrix functioned within the Chacoan system. Morrison (1982) suggests that the signalling system as described could carry information in an ON-OFF or binary manner and as such would carry a very low information load. Morrison suggests that an "array" of fires or signals on the horizon has the potential for carrying much more complex information but evidence for multiple burned areas in close proximity to one another has not been forthcoming. In the absence of such information, Morrison and others (Marshall 1982) feel that signalling from the locations of the Windes' Shrines or Windes' Stone Circles may have served a coordinating function supplementing more complex information probably carried by runners. Scheduling should certainly be taken into account concerning sending and receiving messages, as there seems to be little in the way of evidence for individuals residing within or near Windes' Shrines.

By way of summary, the signalling question remains an unresolved issue. While classes of architecture described herein as Windes' Shrines, Windes' Stone Circles and Herraduras are consistently located in topographic situations of maximum visibility, they show no evidence for the repeated fires necessary for "pyrotechnic" signalling.

Several burned areas are currently known to be located in areas of high visibility but not within the context of the above-mentioned architectural features. The intensity of the burning at these locations suggests that they were subjected to repeated, intense fires such as would be necessary for effective visibility. These locations are situated in the area north of Chaco and consist of the following: three very large firepits constructed against the East Wall at Pueblo Alto (Thomas Windes 1982: personal communication); the pinnacle top (LA 16514) above El Faro at Pierre's Ruin; and a fire pit near the Poco Site. A large fire built in an elevated situation at Pierre's Ruin would be visible from Pueblo Alto and vice versa.

It is interesting that the tangible evidence for large fires should occur in such close association with the alignments of the northern roads only. Michael Marshall (1982: personal communication) feels that there is a close resemblance between the firepit at Pierre's Ruin (LA 16514) and the firepit on the platform backing the large housed kiva at South House at Bis'a'ani. Excavation at Bis'a'ani demonstrated evidence for food preparation in the large firepit on the platform in contrast to an absence of such evidence in the hearth within the kiva.

It seems that several distinct architectural styles (Windes' Shrines, Windes' Stone Circles and Herraduras) are all constructed in topographic situations of high visibility and may have served as locations where signals could be sent or received. Of these site types, only Herraduras are consistently associated with prehistoric road alignments. If one accepts the concept of signalling, then one can postulate the existence of a communication system apart from the corridors represented by the roads.

Road Association Defined in Terms of Functional Relationships--Material Culture Analysis

In the previous section, road-site association was defined in terms of spatial relationships between sites, or individual structures and features within the sites, and the road alignment. In this section, analysis is focused instead on developing a functional definition for road-association by exploring variability in material culture traits (see Figure 9-1).

Dimensions of variability chosen for material culture analysis are shown in Table 9-2. These parameters were considered to be the most sensitive indicators of site function, chronology, interaction and trade. Unique or extreme values for road-associated sites were not expected. However, it was expected that a set of consistent patterns or trends among several variables within the data set would be observed.

Expected Trends in Material Culture Analysis

Dating. Expectations for the age of the roads stemmed mainly from their recognized association with Bonito Phase great houses. Past research has shown that a great house "building boom," dating to around 1050-1125 AD, apparently took place both within Chaco Canyon proper and at several outlying areas. Construction and use of the roads was expected to have commenced within this period.

Jar:Bowl Ratios. Jars are commonly attributed to storage, cooking, and transport functions, while bowls are considered indicative of consumption and service of food. However, jar forms generally predominate in plainware assemblages, and for this reason on early sites dominated by plainware jar:bowl ratios are of less value as an indicator of site function. Generally, in a road-associated (presumably transport) context, a high jar:bowl ratio would be interpreted as indicating that jars were used to carry bulk goods on the road. Low jar:bowl ratios might indicate that the roads served less as a transport medium and more as

TABLE 9-2

DIMENSIONS OF VARIABILITY MONITORED DURING SITE AND ROAD ANALYSIS

Dimensions	Observation
Road Association	
Distance from road.	Absolute value
Elevation with respect to road.	Above, level with
Position with respect to local topography.	On major topographic break, on saddle, on visible prominence or pinnacle, on road edge
Site configuration with respect to road.	Proximal to road, boundaries are coincident with road, features accomodate road alignment, etc.
Architectural Form	
Wall dimension	Meters
Wall configuration	Linear, circular, square, etc.
Masonry style	Rubble core, core-and-veneer, simple, compound, etc.
Construction units	Single, multiple
Mound refief	High, low
Formalized midden	Present, absent
Material Culture Analysis	
Ceramic Assemblage	
Site Date	Ceramic, weighted ceramic and "occupation" dates for beginning, ending, mean, minimum and maximum date
Jar:Bowl Ratios - All Decorated Wares - Intrusive Decorated Wares - Local Decorated Wares	Ratio
Percent Utility Wares - All Utility Wares - Chuska - Cibola	Percentage
Percent Intrusive Wares - All Intrusive Wares - All Intrusives - All Chuskan - Mesa Verde - Redware by Type - Other	Percentage
Lithic Assemblage	
Fire-cracked Rock	Present, Absent
Ground Stone	Present, Absent
Flaked Stone Assemblage	Presence of Formalized Tools, Stages of Manufacture
Flaked Stone Materials	Percentage of Exotics by Type

a communication medium, or that bowls were used in unusually large numbers in a ceremonial or food service context.

Toll (1981) conducted a comparison of jar:bowl ratios at two sites in Chaco Canyon, Pueblo Alto and 29 SJ 627, a small village site. One objective of this analysis was to demonstrate how different activity emphases are indicated by ceramics. Some difference was expected in that Pueblo Alto is a large, possible redistribution center (Toll 1981) associated with the North Road, and 29 SJ 627 is a small village. Results showed that ceramics from Pueblo Alto, during the period between 1040 AD to 1130 AD, had a higher jar:bowl ratio (around 2:1), indicating storage and transport. Conversely, ceramics from 29 SJ 627 had a lower jar:bowl ratio (around 1:2), indicating a more domiciliary assemblage. Based on these results, it was speculated that the road jar:bowl ratios (particularly on the North Road) would be similar to those at Pueblo Alto.

Percent Utility Ware. Utility ware is generally associated with culinary activities in a domiciliary setting. Road-related sites were expected to exhibit lower percentages of utility ware since they were supposedly not primarily the result of domestic habitation.

Percent Intrusives. Since roads were supposedly a focus of trade or interaction between Chacoan settlements or communities, high percentages of intrusive wares in road-associated sites were expected. Franklin (1975), based on his analysis of the sherds Morenon collected on the North Road, believed the direction of transport on the North Road to be from the south to the north, indicating greater movement of goods from Chaco to the San Juan than vice versa. His results showed higher percentages of Cibolan wares, and lower percentages of Mesa Verde wares.

Expectations for Road-Associated Functional Groups

Analysis of material culture variability was also structured around predictions as to types of sites which were likely to be road-related. These site categories were defined on the basis of road-site spatial relationships, as well as on the basis of physical characteristics of sites as discussed earlier. The following site types were expected to exhibit road-associated material culture traits:

Zambullidas
Herraduras
great houses
Avanzadas
Lithic/Ceramic sites in Direct Association
Ceramic/Lithic sites in Direct Association
Ceramic sites in Direct Association

Sites not expected to exhibit road-associated material culture traits were those in Simple Physical Proximity to the road alignment, without unique physical characteristics:

Lithic/Ceramic sites in Proximity
Ceramic/Lithic sites in Proximity
Ceramic Sites in Proximity
Roomblocks

Lithic sites were analyzed separately.

Analytical Procedures

The analysis of site-specific ceramic information was greatly enhanced by the use of the computer facilities at the Laboratory of Anthropology in Santa Fe. Each site recorded during the project was encoded on the Archaeological Records Management (ARM) encoding form and entered into the Laboratory of Anthropology ARM data base. With the generous assistance of Tim Seaman, who acted as project consultant, two additional data files were established specifically for this project. One of these files, the "Site File Supplement" contained information on temporal affiliation, location of visible swales, attributes of visible swales, and a number of other types of data. A dictionary for this file is presented in Table 9-3, and a sample printout is shown in Figure 9-12.

A second file was established which contained detailed information on the ceramics recorded for each site. This included the number of sherds by ware, type and vessel form. The manipulation of both these files provided the bulk of the ceramic analysis information utilized in this report. A listing of all of the ceramic types identified during the survey, along with information on how they were used in the analysis, is shown in Table 9-4.

In three cases sites were included in the functional group analysis which were not identified in the corridor survey, in order to increase site counts and ceramic sample sizes. Three examples of Herraduras were included from other roads, two from the Casa del Rio to Lake Valley Road, and one from the South Gap to Kin Bineola Road. One Avanzada was added to the functional analysis from the Casa del Rio to Lake Valley Road. Nine great houses were added to the functional analysis from a number of different peripheral road systems. These additional sites were omitted from both the road-specific corridor analyses and the analyses of functional groups by road system.

Dating. In dating prehistoric roads, it is important to maintain the distinction between the date of road construction and the span of road use. To establish dates for actual road construction one would need

CONTENTS OF SAS DATA SET BASE.ROADSEG

TRACKS USED=5 SUBEXTENTS=2 OBSERVATIONS=169 CREATED BY JOB MMXC001T AT 10:00 MONDAY, MAY 17, 1982 BY SAS RELEASE 79.5

DSNAME=MM1.CRP.BASE BLKSIZE=19069 LRECL=261 OBSERVATIONS PER TRACK=73 GENERATED BY DATA

ALPHABETIC LIST OF VARIABLES

#	VARIABLE	TYPE	LENGTH	POSITION	FORMAT	INFORMAT	LABEL
4	BEGIN	NUM	8	23			BEGIN OCCUPATION DATE
37	C_BEGIN	NUM	8	229			M_DATE - 1 STD DEV
38	C_END	NUM	8	237			M_DATE + 1 STD DEV
27	DATING	CHAR	4	153			DATING CLASSIFICATION
3	DIST	NUM	8	15			DISTANCE IN METERS FROM ROAD CENTER
5	END	NUM	8	31			END OCCUPATION DATE
29	GROUP	NUM	8	165			ANALYTICAL GROUP
1	LANO	NUM	8	4			LAB OF ANTH SITE NUMBER
31	M_DATE	NUM	8	181			MEAN CERAMIC DATE
34	MAXD	NUM	8	205			LATEST CERAMIC TYPE DATE
30	MEDATE	NUM	8	173			MEDIAN OCCUPATION DATE
33	MIND	NUM	8	197			EARLIEST CERAMIC TYPE DATE
7	NUTME	NUM	8	47			N END OF ROADSEG-UTM E
6	NUTMN	NUM	8	39			N END OF ROADSEG-UTM N
24	R_AZM	NUM	8	135			ROADSEG AZMITH IN DEGREES
14	R_BEDR	NUM	2	79	BEDRF16.		ROADSEG BEDROCK
25	R_BORDER	NUM	2	143	BORDERF16.		ROADSEG BORDER ELEMENT
23	R_DEPTH	NUM	8	127			ROADSEG DEPTH IN METERS
21	R_LENGTH	NUM	8	111			ROADSEG LENGTH IN METERS
15	R_SL_ANG	NUM	8	81			ROADSEG SLOPE ANGLE
17	R_SL_AZM	NUM	8	97			ROADSEG SLOPE AZMITH
18	R_SL_CON	NUM	2	105	SLCONDF16.		ROADSEG SLOPE CONDITION
20	R_SL_EAG	NUM	2	109	ERAGENTF16.		ROADSEG SLOPE ERODING AGENT
19	R_SL_ERO	NUM	2	107	EROSF16.		ROADSEG SLOPE EROSION
16	R_SL_LEN	NUM	8	89			ROADSEG SLOPE LENGTH
13	R_SUBST	NUM	2	77	SUBSTF16.		ROADSEG SUBSTRATE
10	R_TOPO	NUM	2	71	TOPOF16.		ROADSEG TOPOGRAPHY
11	R_VEG	NUM	2	73	VEGF16.		ROADSEG VEGETATION
12	R_VEGD	NUM	2	75	VEGDIFF16.		ROADSEG VEG DIFFERENCE
22	R_WIDTH	NUM	8	119			ROADSEG WIDTH IN METERS
2	ROADNO	NUM	3	12	ROADF16.		ROAD ASSOCIATION
28	SFUNCT	NUM	8	157	SFUNCTF16.		SITE FUNCTIONAL CLASSIFICATION
32	STD	NUM	8	189			STD DEVIATION OF M_DATE
9	SUTME	NUM	8	63			S END OF ROADSEG-UTM E
8	SUTMN	NUM	8	55			S END OF ROADSEG-UTM N
39	WC_BEGIN	NUM	8	245			WM_DATE - 1 STD DEV
40	WC_END	NUM	8	253			WM_DATE + 1 STD DEV
35	WM_DATE	NUM	8	213			WEIGHTED MEAN CERAMIC DATE
36	WSTD	NUM	8	221			STD DEVIATION OF WM_DATE
26	ZONE	NUM	8	145			UTM ZONE

Table 9-3. Dictionary for Site File Supplement

LAND	ROADNO	DIST	BEGIN	END	NUTMN	NUTME	SUTMN	SUTME	R_TOPO	R_VEG
34303.0	NORTH ROAD	0	1000	1100	.	.	.	.	.	.
34304.0	NORTH ROAD	0	1000	1125	.	.	.	.	.	.
34305.0	NORTH ROAD	0	1080	1125	.	.	.	.	.	.
34306.0	NORTH ROAD	0	1000	1050	.	.	.	.	.	.
34307.0	NORTH ROAD	0	1000	1050	.	.	.	.	.	.
34307.1	NORTH ROAD	25	1950	1960	.	.	.	.	.	.
34308.0	PB-AH ROAD	25	1000	1125	3998570	769348	.	.	ROLLING UPLANDS	SN/SALT/GR/CA
34309.0	PB-AH ROAD	0	1000	1125	3998224	769543	3998046	769653	ROLLING UPLANDS	SN/SALT/GR
34310.0	PB-AH ROAD	0	1000	1125	3998447	769390	3998280	769500	ROLLING UPLANDS	SN/SALT/GR/SG
34311.0	PB-AH ROAD	0	1000	1125	3998730	769249	.	.	ROLLING UPLANDS	SN/SALT/GR/CA
34311.1	PB-AH ROAD	25	1960	1970	.	.	.	.	.	.
34312.0	PB-AH ROAD	0	1000	1125	3998891	769152	.	.	ROLLING UPLANDS	SN/SALT/GR/CA

LAND	R_VEGD	R_SUBST	R_BEDR	R_SL_ANG	R_SL_LEN	R_SL_AZM	R_SL_CON
34303.0	.	.	.	.	.	.	.
34304.0	.	.	.	.	.	.	.
34305.0	.	.	.	.	.	.	.
34306.0	.	.	.	.	.	.	.
34307.0	.	.	.	.	.	.	.
34307.1	.	.	.	.	.	.	.
34308.0	ABSENT	COLLUVIUM	SANDSTONE	4	500	30	OCCASS IRREG
34309.0	ABSENT	STABILZD DUNES	SANDSTONE	5	130	.	OCCASS IRREG
34310.0	ABSENT	STABILZD DUNES	SANDSTONE	3	100	.	OCCASS IRREG
34311.0	ABSENT	ABSENT	SANDSTONE	0	0	0	OCCASS IRREG
34311.1	.	.	.	.	.	.	.
34312.0	ABSENT	ABSENT	SANDSTONE	0	0	0	OCCASS IRREG

Figure 9-12. Sample Printout for Site File Supplement

LAND	R_SL_ERO	R_SL_EAG	R_LENGTH	R_WIDTH	R_DEPTH	R_AZM	R_BORDER	ZONE	DATING
34303.0	.	.	.	.	.	.	.	13	PREH
34304.0	.	.	.	.	.	.	.	13	PREH
34305.0	.	.	.	.	.	.	.	13	PREH
34306.0	.	.	.	.	.	.	.	13	PREH
34307.0	.	.	.	.	.	.	.	13	PREH
34307.1	.	.	.	.	.	.	.	.	HIST
34308.0	SOMEWHAT ERODED	WATER	80	8	0.30	330	BERM	12	PREH
34309.0	SOMEWHAT ERODED	WATER	245	12	0.55	330	ISOL BORDER ELEM	12	PREH
34310.0	STRONGLY ERODED	WATER	100	18	0.65	325	BERM/CURB/ISO EL	12	PREH
34311.0	SOMEWHAT ERODED	WIND/WATER/HACT	30	9	0.50	335	ABSENT	12	PREH
34311.1	.	.	.	.	.	.	.	.	HIST
34312.0	SOMEWHAT ERODED	WATER	22	12	.	335	CURB/ISOL ELEM	12	PREH

LAND	SFUNCT	GROUP	MEDATE	M_DATE	STD	MIND	MAXD	WM_DATE	WSTD	C_BEGIN	C_END	WC_BEGIN	WC_END
34303.0	MASONRY STRS	35	1050.0	1113.16	10.601	1087.5	1150.0	1114.94	12.466	1102.56	1123.76	1102.48	1127.41
34304.0	MASONRY STRS	35	1062.5	1090.00	74.083	900.0	1150.0	1040.78	103.639	1015.92	1164.08	937.15	1144.42
34305.0	MASONRY STRS	35	1102.5	1112.50	0.000	1112.5	1112.5	1112.50	0.000	1112.50	1112.50	1112.50	1112.50
34306.0	MASONRY STRS	35	1025.0	1095.83	25.820	1062.5	1112.5	1082.50	24.495	1070.01	1121.65	1058.01	1106.99
34307.0	MASONRY STRS	35	1025.0	1045.83	86.843	900.0	1150.0	1003.15	90.927	958.99	1132.68	912.22	1094.08
34307.1	HISTORIC COMPNTS	16	.	.	.	.	.	.	.	.	.	.	.
34308.0	CER SC IN PROX	34	1062.5	981.25	114.905	900.0	1062.5	952.70	76.070	866.35	1096.15	876.63	1028.77
34309.0	VIS SW W/O MATL	40	1062.5	1150.00	.	1150.0	1150.0	1150.00	.	.	.	.	.
34310.0	CER SC:DIR ASSN	15	1062.5	1114.92	16.625	1062.5	1150.0	1115.47	21.760	1098.30	1131.55	1093.71	1137.23
34311.0	CER SC:DIR ASSN	15	1062.5	1043.75	104.333	900.0	1150.0	1002.21	95.215	939.42	1148.08	907.00	1097.43
34311.1	HISTORIC COMPNTS	18	.	.	.	.	.	.	.	.	.	.	.
34312.0	VIS SW W/O MATL	40	1062.5	.	.	.	.	.	.	.	.	.	.

Figure 9-12, Page 2

TYPECODE	TYPE	C_BEGIN	C_END	C_MDATE	C_SPAN	C_WT	TYPECAT	TRADE
1.01	PL-UNDIF TEMP SZ	.	.	.	.	.	PLA	LOCA
1.02	PL-CRS TEMP	800	875	837.5	75	0.0133333	PLA	LOCA
1.03	PL-FINE TEMP	.	.	.	.	.	PLA	LOCA
1.04	BANDED-UNDIF	800	950	875.0	150	0.0066667	PLA	LOCA
1.05	BANDED-WIDE	800	875	837.5	75	0.0133333	PLA	LOCA
1.06	BANDED-NARROW	850	950	900.0	100	0.0100000	PLA	LOCA
1.07	INCS/INCS CORRUG	875	1000	937.5	125	0.0080000	PLA	LOCA
1.08	CORRUG-UNDIF	925	1300	1112.5	375	0.0026667	PLA	LOCA
1.09	CORRUG-MEDICINE	925	1050	987.5	125	0.0080000	PLA	LOCA
1.10	CORRUG-TUSAYAN	1050	1300	1175.0	250	0.0040000	PLA	LOCA
2.01	UNDIAG-UNDIFTPSZ	.	.	.	.	.	B/W	LOCA
2.02	UNDIAG-CRS TP	.	.	.	.	.	B/W	LOCA
2.03	UNDIAG-FINE TP	.	.	.	.	.	B/W	LOCA
2.04	LA PLATA/WH MND	725	850	787.5	125	0.0080000	B/W	LOCA
2.05	RED MESA B/W	870	1080	975.0	210	0.0047619	B/W	LOCA
2.06	ESCAVADA B/W	925	1125	1025.0	200	0.0050000	B/W	LOCA
2.07	GALLUP B/W	1000	1125	1062.5	125	0.0080000	B/W	LOCA
2.08	CHACO B/W	1050	1125	1087.5	75	0.0133333	B/W	LOCA
2.09	LINO B/G	575	875	725.0	300	0.0033333	B/W	LOCA
3.01	UNDIAG	.	.	.	.	.	B/W	INTR
3.02	CORTEZ B/W	900	1000	950.0	100	0.0100000	B/W	INTR
3.03	MCELMO B/W	1050	1250	1150.0	200	0.0050000	B/W	INTR
3.04	MESA VERDE B/W	1270	1340	1305.0	70	0.0142857	B/W	INTR
3.05	MANCOS B/W	1075	1125	1100.0	50	0.0200000	B/W	INTR
4.01	PLAIN	700	850	775.0	150	0.0066667	PLA	INTR
4.02	BANDED-WIDE	800	875	837.5	75	0.0133333	PLA	INTR
4.03	BANDED-NARROW	850	950	900.0	100	0.0100000	PLA	INTR
4.04	INCS/INCS CORRUG	875	1000	937.5	125	0.0080000	PLA	INTR
4.05	CORRUG-UNDIF	875	1300	1087.5	425	0.0023529	PLA	INTR
4.06	CORRUG-MEDICINE	875	950	912.5	75	0.0133333	PLA	INTR
4.07	CORRUG-TUSAYAN	925	1300	1112.5	375	0.0026667	PLA	INTR
4.08	BANDED-UNDIF	.	.	.	.	.	PLA	INTR
4.09	PLAIN INCISED	.	.	.	.	.	PLA	INTR
5.01	UNDIAG	.	.	.	.	.	B/W	INTR
5.02	RED MESA STYLE	875	1000	937.5	125	0.0080000	B/W	INTR
5.03	SOLID STYLE	975	1250	1112.5	275	0.0036364	B/W	INTR
5.04	HATCHURE STYLE	1000	1125	1062.5	125	0.0080000	B/W	INTR
5.05	LA PLATA STYLE	750	875	812.5	125	0.0080000	B/W	INTR
5.06	MESA VERDE STYLE	1150	1300	1225.0	150	0.0066667	B/W	INTR
6.01	WHITE MTN-UNDIF	1075	1130	1102.5	55	0.0181818	RED	INTR
6.02	SAN JUAN-UNDIF	700	900	800.0	200	0.0050000	RED	INTR
6.03	TSEGI ORANGEWARE	1150	1300	1225.0	150	0.0066667	RED	INTR
6.04	CHUSKA SAN JUAN	825	875	850.0	50	0.0200000	RED	INTR
6.05	UNDIFF REDWARE	.	.	.	.	.	RED	INTR
6.06	PUERCO B/R	1075	1130	1102.5	55	0.0181818	RED	INTR
6.07	WINGATE B/R	1075	1130	1102.5	55	0.0181818	RED	INTR
6.08	WINGATE POLY	1075	1200	1137.5	125	0.0080000	RED	INTR
6.09	ST JOHNS POLY	1200	1300	1250.0	100	0.0100000	RED	INTR
7.01	SOCORRO B/W	1050	1275	1162.5	225	0.0044444	B/W	INTR
7.02	KAYENTA WH WARE	1075	1300	1187.5	225	0.0044444	B/W	INTR
7.03	MOGOLLON BROWN	.	.	.	.	.	PLA	INTR
7.04	NAVAJO UTIL WARE	.	.	.	.	.		
7.05	INDET WH WARE	.	.	.	.	.	B/W	
7.06	CHACO/MCELMO	1100	1175	1137.5	75	0.0133333	B/W	LOCA
7.07	SHOWLOW SMUDGED	.	.	.	.	.	PLA	INTR
7.08	NAVA B/W	1100	1175	1137.5	75	0.0133333	B/W	INTR

datable material obtained directly from some features of the constructed road surface or from within the border elements. Until information of this type can be developed, accurate road construction dates remain problematical. The following analysis depends primarily on chronological data from sites thought to be road-associated, and is thus considered more indicative of the span of use. The proposition that it is possible to date road use by dating sites considered to be road-associated is being both suggested and tested.

Procedures. Two main types of analyses were utilized in developing a chronology for sites and for functional groups. The first involved the determination of beginning, ending, mean, minimum, and maximum dates based on the dates of the ceramic types represented in the assemblage. The second involved the comparison of ceramic frequency graphs derived from information generated during computer analysis. These analyses are described in the following paragraphs.

The Statistical Analysis Summary (SAS) program was utilized to generate two types of information: 1) the beginning, ending, mean, minimum and maximum dates (described below), and 2) the mean, median, mode, standard deviation, coefficient of variability, and inter-quartile range (the range of the middle 50 percent of all values). A sample printout is provided in Figure 9-13.

Determination of Beginning, Ending and Mean Dates. Three different techniques were used to arrive at the beginning, ending and mean dates in order to test the comparability of different ceramic date sources as described below. Because the minimum and maximum dates are based on the span dates for each ceramic type (see Table 9-4), and these did not change during the course of analysis, only a single procedure will be discussed for each.

"OCCUPATION" DATES. Occupation dates were generated for each site using dating criteria presented by Marshall et al. (1979). This method compares relative proportions of plain and corrugated types within the utility category, relative proportions of Red Mesa and related wares to solid and hatchured styles (Escavada, Gallup and Chaco B/W), and the presence of such intrusives as carbon-painted white wares and White Mountain Red wares. These criteria are presented in Table 9-5.

UNWEIGHTED CERAMIC DATES. Ceramic dates were generated for each site by computer analysis based on the dendrochronological dates for each ceramic type present. This technique is similar to the one used by Morenon (1977) in dating the North Road. For a specific methodological discussion of this procedure, see South (1977) and Gomolack (1980).

The process of generating Ceramic dates involved the following steps. First, the range of dates for each ceramic type was determined based on Breternitz (1966), Windes (1977b) and Stewart Peckham (1982: personal communication). The mid-point of the range for each type was then defined as the mean for that type. The Ceramic Mean date for each assemblage was then calculated by assigning each sherd the value of the mean date assigned to its type and averaging the dates for all sherds. The Ceramic Beginning date for each assemblage was determined by subtracting one standard deviation from the Ceramic Mean date, and a Ceramic Ending date by adding one standard deviation. When the beginning, ending and mean dates for each individual site were established, Ceramic dates for each road corridor, each functional group and each functional group by road corridor could be calculated. The formula used for arriving at group dates was:

$$\text{Group Date} = \frac{\text{Sum of Ceramic or Weighted (Beginning, Ending or Mean) Dates for all sites in Group}}{\text{Number of Sites in Group}}$$

WEIGHTED CERAMIC DATES. Weighted Ceramic dates were generated for sites by weighting each ceramic type present according to the length of span. The formula used for calculating the weighting factor was:

$$\text{Weight} = \frac{1}{\text{Span in Years of Ceramic Type}}$$

Thus, Chaco B/W with a span of 75 years (1050-1125 AD) would tend to weigh more heavily than McElmo B/W with a span of 200 years (1050-1250 AD). Following the same procedures as for Ceramic Dates, a Weighted Ceramic Mean date, Weighted Ceramic Beginning date, and a Weighted Ceramic End date were calculated for each site and analysis group.

Comparison of Dating Techniques. Comparisons of Occupation dates, Ceramic dates and Weighted Ceramic dates showed that, in general, the dates were of sufficient similarity to reaffirm the validity of each approach. A slight trend toward exaggeration of lateness of later sites and earliness of early sites was noted in the Ceramic and Weighted Ceramic dates. Weighted Ceramic dates were generally more comparable with the Occupation dates and for this reason the decision was made to use this set of dates as the basis for site and group comparisons.

Determination of Minimum and Maximum Dates: These dates theoretically represent the earliest and latest dates for any ceramic type present in a site assemblage. Although these dates may represent the span of occupation, they do not necessarily reflect the most intense occupational episode.

As might be expected, there were considerable differences between the Minimum and Maximum dates and the Ceramic and Weighted Ceramic Beginning and Ending dates. For example, an assemblage may have been comprised of one sherd of La Plata B/W and 50 sherds of Red Mesa B/W. The Minimum date would then

BUREAU OF LAND MANAGEMENT
CHACO ROAD PROJECT
WEIGHTED MEAN CERAMIC DATING
LAB OF ANTH SITE NUMBER=34208

UNIVARIATE

VARIABLE=C_MDATE CERAMIC TYPE MEDIAN DATE
WEIGHT C_WT CERAMIC TYPE WEIGHTING FACTOR

MOMENTS

N	178	SUM WGTS	2.09623
MEAN	855.811	SUM	1793.98
STD DEV	64.881	VARIANCE	4209.55
SKEWNESS	.	KURTOSIS	.
USS	1544127	CSS	8824.18
CV	7.58124	STD MEAN	4.86304
T:MEAN=0	175.983	PROB>|T|	0.0001

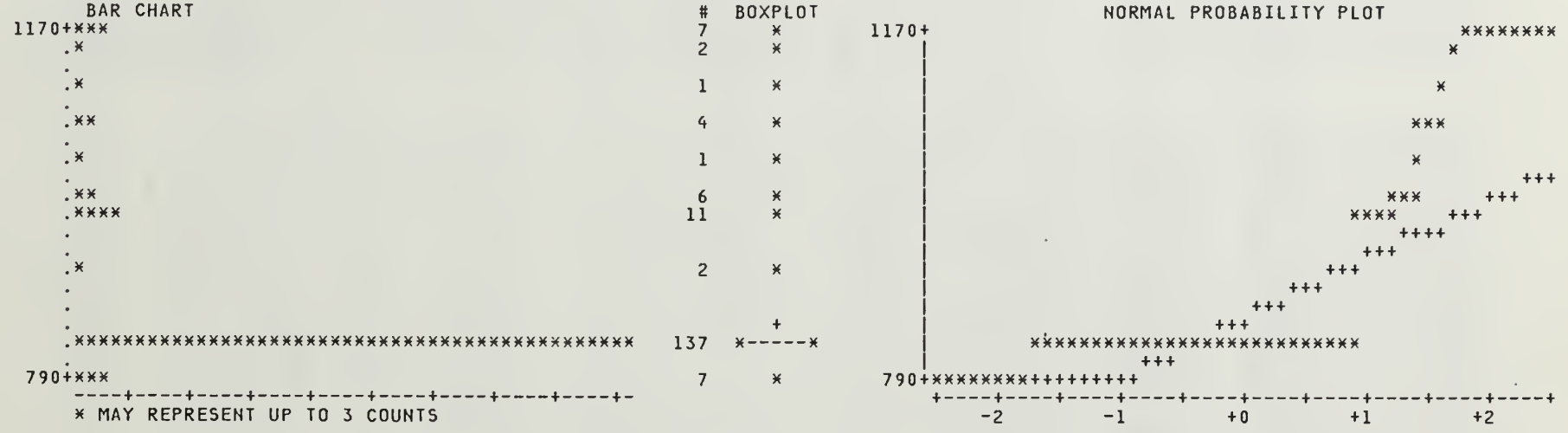
QUANTILES(DEF=4)

100% MAX	1175	99%	1175
75% Q3	837.5	95%	1150
50% MED	837.5	90%	987.5
25% Q1	837.5	10%	837.5
0% MIN	787.5	5%	837.5
		1%	787.5
RANGE	387.5		
Q3-Q1	0		
MODE	837.5		

EXTREMES

LOWEST	ID	HIGHEST	ID
787.5(	2.04)	1062.5(	2.07)
787.5(	2.04)	1102.5(	6.01)
837.5(	1.05)	1150(	3.03)
837.5(	1.05)	1175(	1.1)
837.5(	1.02)	1175(	1.1)

MISSING VALUE .
COUNT 20
% COUNT/NOBS 10.10



FREQUENCY TABLE

VALUE	COUNT	PERCENTS CELL	CUM	VALUE	COUNT	PERCENTS CELL	CUM	VALUE	COUNT	PERCENTS CELL	CUM	VALUE	COUNT	PERCENTS CELL	CUM
787.5	7	3.9	3.9	975	11	6.2	88.2	1062.5	4	2.2	94.4	1175	7	3.9	100.0
837.5	137	77.0	80.9	987.5	6	3.4	91.6	1102.5	1	0.6	94.9				
900	2	1.1	82.0	1025	1	0.6	92.1	1150	2	1.1	96.1				

Figure 9-13. Example of Site Ceramic Analysis Format

TABLE 9-5

OCCUPATION DATES, DEVELOPED BY MARSHALL AND OTHERS

Period	Estimated Dates	Ceramic Associations
Basket Maker III	A. D. 450 or 500 to 725	Abundance of Plain gray, with Lino style white ware.
Pueblo I		
Early	A. D. 725-850	Abundance of plain and banded gray ware. Lino and Kana'a style white ware. Trace of Red Mesa style.
Late	A. D. 850-950	Plain and banded with trace of corrugated-indented in Medicine style. Red Mesa style dominant.
Pueblo II		
Early	A. D. 950-1000	Plain, banded, and corrugated-indented styles frequent, Red Mesa style abundant with traces of solid and Gallup styles.
Late	A. D. 1000-1050	Corrugated-Indented abundant with lesser quantities of plain and banded. Solid and Gallup style predominant with traces of Red Mesa style.
Pueblo III		
Early	A. D. 1050-1125	Corrugated-Indented abundant with lesser quantities of plain and banded. Solid and Gallup style predominant with traces of Red Mesa style. Addition of Puerco B/R and Wingate B/R.
Middle	A. D. 1125-1175	Corrugated-Indented abundant with lesser quantities of plain and banded. Solid and Gallup style predominant with traces of Red Mesa style. Addition of Houck (Syn. Wingate) Polychrome.
Late	A. D. 1175-1250 or 1300	Corrugated-Indented abundant with lesser quantities of plain and banded. Solid and Gallup style predominant with traces of Red Mesa style. Addition of St. John's Polychrome, Tularosa B/W and Mesa Verde B/W.
Pueblo IV	A. D. 1300-1540	Heshotauthla Polychrome A. D. 1300 begins this horizon.

Source: Marshall et al. 1979. Courtesy Public Service Company of New Mexico and the Historic Preservation Bureau, Planning Division, State of New Mexico.

reflect the La Plata B/W (AD 725), while the Ceramic Mean date would be much higher, reflecting the heavier influence of the Red Mesa B/W (AD 870-1090).

Minimum and Maximum dates were determined for all sites, for each road corridor individually, for each functional group and for each functional group by road corridor. The formula for determining group Minimum and Maximum dates was:

$$\text{(Min-D) or (Max-D)} = \frac{\text{Sum of (Min-D) or (Max-D) of all Sites}}{\text{Number of Sites in Group}}$$

Again, it should be kept in mind that Minimum and Maximum dates do not necessarily reflect intensive or even limited occupation dates and are useful only as an indication of the presence of extreme dates for ceramic types.

Ceramic Frequency Graphs. The mean date was initially used for site evaluation because it could be consistently and quickly generated for individual sites and groups of sites and was easily compared between analytical groups. However a comparison of the standard deviation and the inter-quartile range clearly showed that substantial variability in span and mode of ceramic types present was masked by the use of the mean date as a measure of site or group temporal affiliation. Since it was difficult to control all these variables through time for large numbers of sites, effective comparisons of patterns of variability were possible only on a limited basis. To address this problem ceramic frequency graphs were prepared. In these graphs (see Figure 9-14) the percentage of the total datable ceramic assemblage (as opposed to the absolute sherd count) is plotted against the mean span date for each ceramic type represented.

In utilizing ceramic frequencies there is always a possibility of "noise" or contamination by earlier or later occupants of a site. In addition, the number of types causing an observed pattern, the span of each type and the representation of these types in other sites in the area can all affect the reliability and utility of ceramic frequency as a temporal indicator. Because this problem remains unresolved, information has been provided to allow the reader to evaluate the credibility of the ceramic frequency graphs. A time-line of mean dates of all of the datable ceramic types appears across the bottom of the page with each ceramic frequency graph. To determine the ceramic types responsible for the observed frequency value, refer to this time line. Here coded ceramic types are plotted by mean dates (for example, ceramic type 2.05 has a mean date of 975 AD). Conventional type names corresponding to all the coded values are listed in Table 9-4 (e.g., ceramic type 2.05 is the coded name for Red Mesa B/W). To assess the precision with which any individual ceramic type can be used as a chronological indicator, mean dates were plotted against span dates, as shown in Figure 9-15.

No attempt was made to calculate the actual numbers of vessels represented in each of the ceramic categories. Although there are methods of translating a collection of sherds into a quantity of vessels which correct gross discrepancies between sherd counts of large jar forms and small bowl forms (Lekson 1977b), these methods were not utilized in the current study.

Jar:Bowl Ratios. Field documentation of ceramic material included classification of vessel form into "Jar," "Bowl" or "Indeterminate" categories. During analysis, jar:bowl ratios were calculated first for all decorated wares; decorated wares were then divided into intrusive and local wares and ratios calculated separately for these.

Recognition of jar and bowl forms was based on the presence of slip and paint on either the interior (for bowls) or exterior (for jars) of the vessel. Utility wares in the "plain" category may be either bowls or jars and are difficult to distinguish; however, according to Toll (1981), Anasazi grey wares are almost all jars. Banded and corrugated utility styles represent jar forms, so a large percentage of "plain ware" sherds are probably body sherds to neck-banded or corrugated vessels. A high frequency of sherds were classified in the "Indeterminate" vessel form category, which proved to be a catch-all for plain ware sherds lacking rims, smoothing, or scraping marks and painted white ware sherds too small to allow determination of vessel form.

Percent Utility Ware. The percent of utility ware was monitored for each analytical group. Figures for the total utility percentage were determined, as well as separate figures for Cibola Utility and Chuska Utility.

Percent Intrusive Ware. Because ceramics are clearly one item being moved within the Chacoan system, they have the potential for providing valuable information relating to scale, distance and direction of exchange (Toll, Windes and McKenna 1980:98). Most intrusive ceramic material in the central Basin floor consists of wares originating in the San Juan and Mesa Verde regions to the north, the Chuska slopes to the west and the Little Colorado River Valley to the southwest.

Mesa Verde. Analysis of intrusive Mesa Verdean ceramic material presented some problems in the field which ultimately carried over into interpretation of specific assemblages. Basically, the problems stem from an inability to consistently differentiate between Mesa Verdean and Cibolan Wares using traditional field examination techniques. Crushed andesitic rock is considered diagnostic of Mesa Verdean affiliation; without the aid of a microscope, however, this trait cannot be consistently recognized. Traditionally, archaeologists have followed certain conventions in performing field classification which have tended to differentially skew ceramic counts

FIGURE 9-14 CERAMIC FREQUENCY GRAPHS

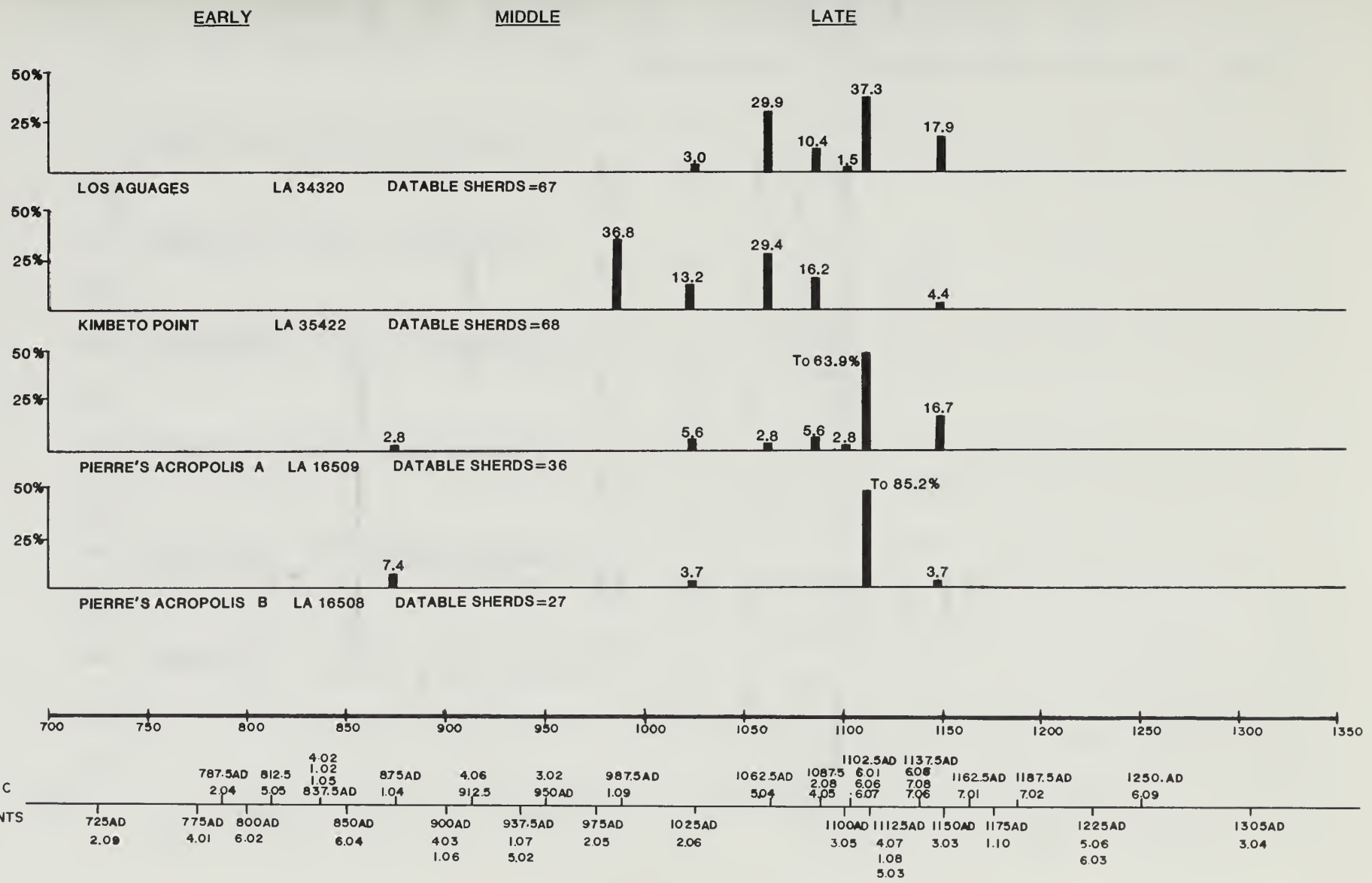


FIGURE 9-14, PAGE 2

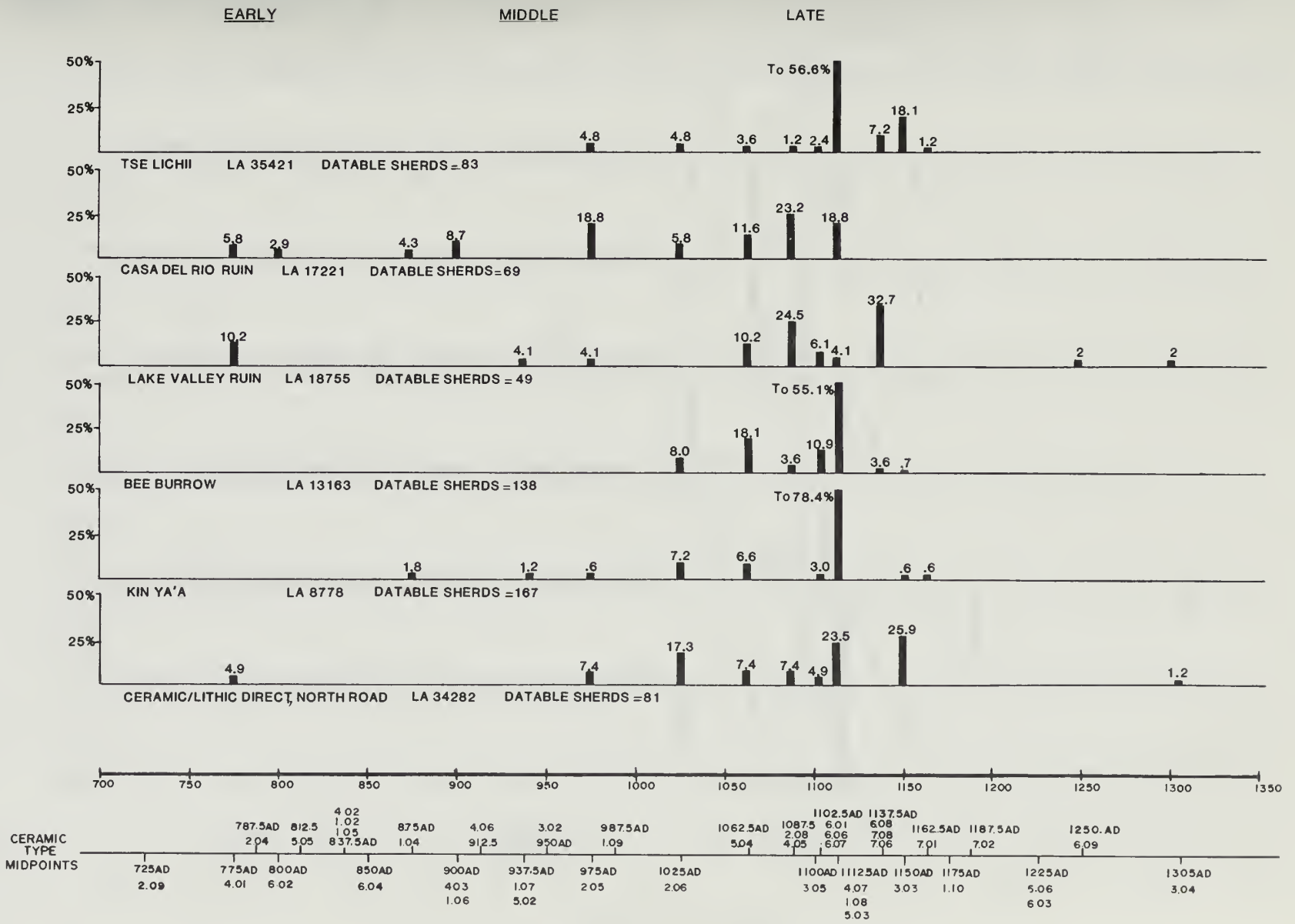
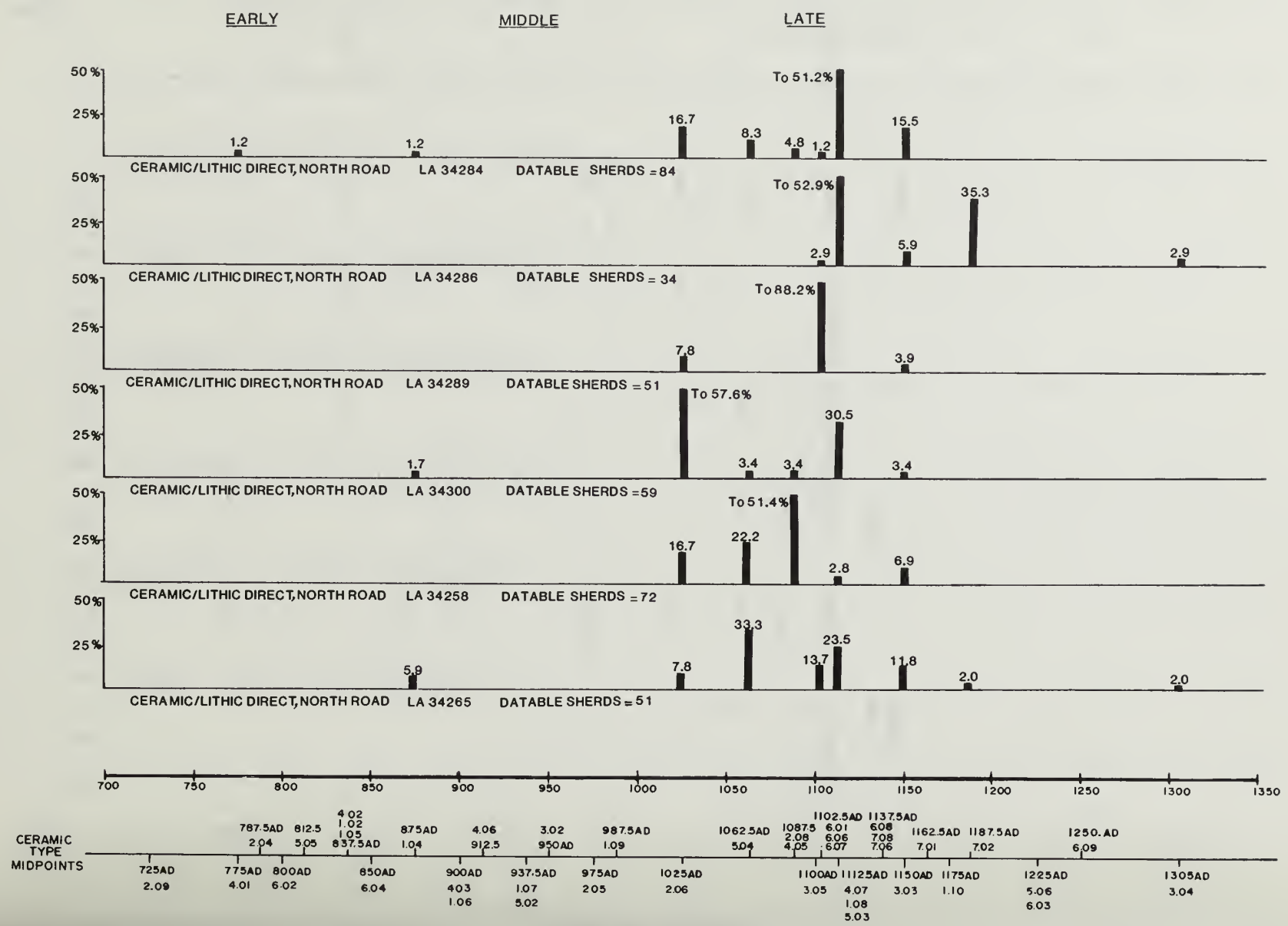
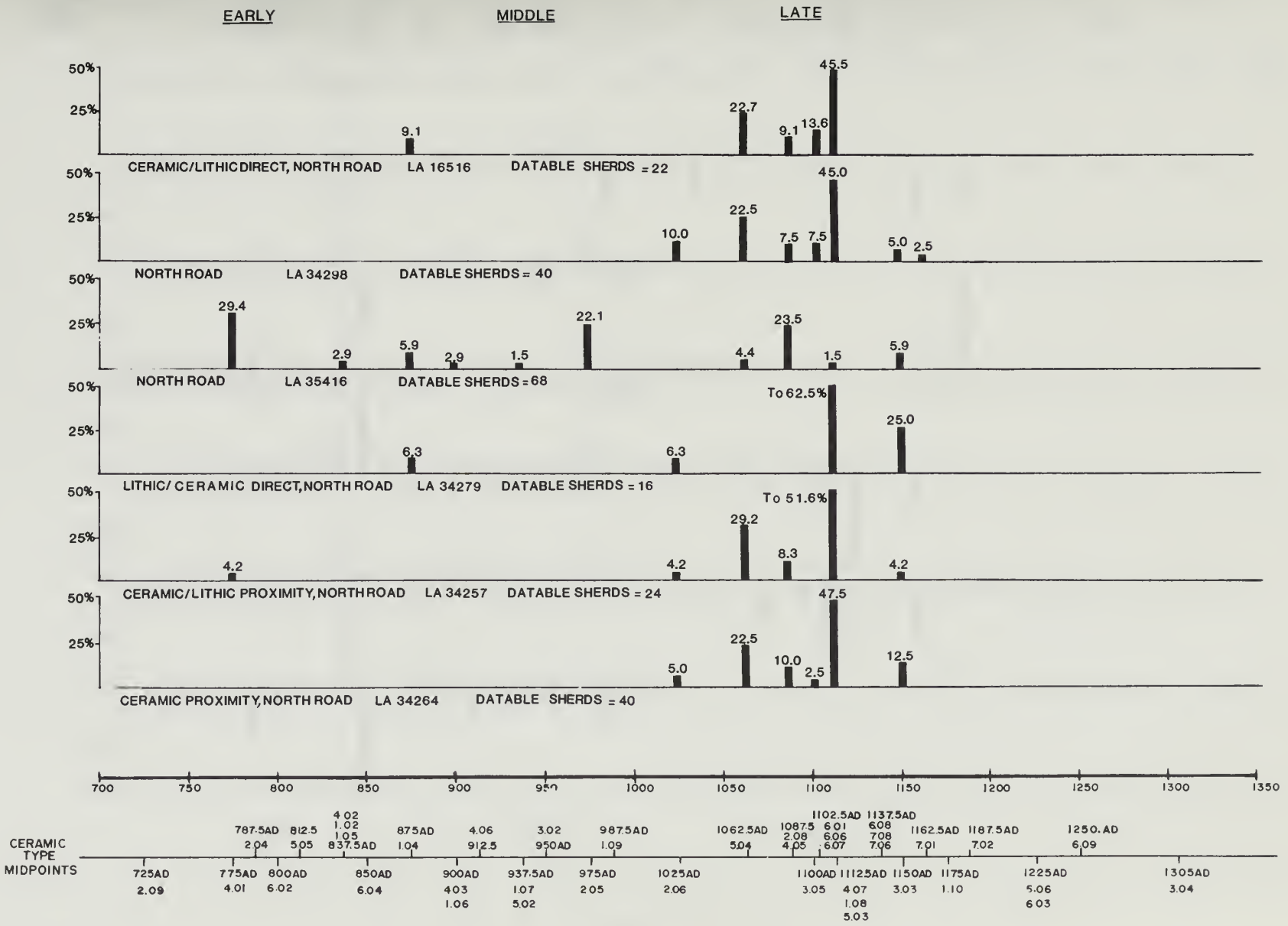
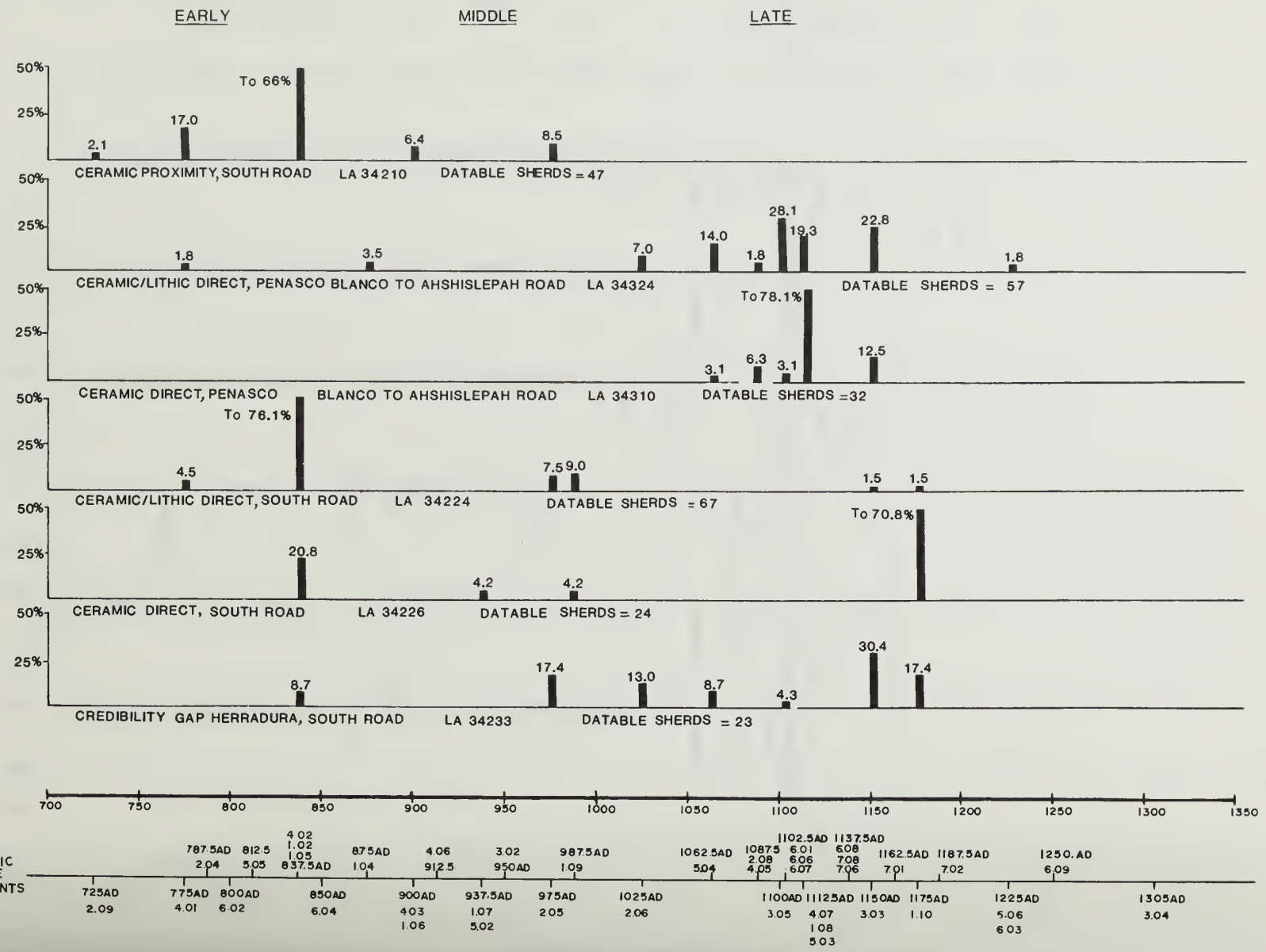

EARLY
MIDDLE
LATE
50%
25%
To 56.6%
4.8
4.8
3.6
1.2
2.4
7.2
18.1
1.2
TSE LICHII LA 35421 DATABLE SHERDS=83
5.8
2.9
4.3
8.7
18.8
5.8
11.6
23.2
18.8
CASA DEL RIO RUIN LA 17221 DATABLE SHERDS=69
10.2
4.1
4.1
10.2
24.5
6.1
4.1
32.7
2
2
LAKE VALLEY RUIN LA 18755 DATABLE SHERDS = 49
To 55.1%
8.0
18.1
3.6
10.9
3.6
.7
BEE BURROW LA 13163 DATABLE SHERDS =138
To 78.4%
1.8
1.2
.6
7.2
6.6
3.0
.6
.6
KIN YA'A LA 8778 DATABLE SHERDS =167
4.9
7.4
17.3
7.4
7.4
4.9
23.5
25.9
1.2
CERAMIC/LITHIC DIRECT, NORTH ROAD LA 34282 DATABLE SHERDS =81
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
CERAMIC TYPE MIDPOINTS
725AD 2.09
775AD 4.01
787.5AD 2.04
800AD 6.02
812.5 5.05
850AD 6.04
4.02 1.02 1.05 837.5AD
875AD 1.04
900AD 4.03 1.06
4.06 912.5
937.5AD 1.07 5.02
3.02 950AD
975AD 2.05
987.5AD 1.09
1025AD 2.06
1062.5AD 5.04
1087.5 2.08 4.05
1100AD 3.05
1102.5AD 6.01 6.06 6.07
1125AD 4.07 1.08 5.03
1137.5AD 6.08 7.08 7.06
1150AD 3.03
1162.5AD 7.01
1175AD 1.10
1187.5AD 7.02
1225AD 5.06 6.03
1250.AD 6.09
1305AD 3.04

FIGURE 9-14, PAGE 4




EARLY
MIDDLE
LATE
50%
25%
9.1
22.7
9.1
13.6
45.5
CERAMIC/LITHIC DIRECT, NORTH ROAD LA 16516 DATABLE SHERDS = 22
10.0
22.5
7.5
7.5
45.0
5.0
2.5
NORTH ROAD LA 34298 DATABLE SHERDS = 40
29.4
2.9
5.9
2.9
1.5
22.1
4.4
23.5
1.5
5.9
NORTH ROAD LA 35416 DATABLE SHERDS = 68
6.3
6.3
To 62.5%
25.0
LITHIC/ CERAMIC DIRECT, NORTH ROAD LA 34279 DATABLE SHERDS = 16
4.2
4.2
29.2
8.3
To 51.6%
4.2
CERAMIC/LITHIC PROXIMITY, NORTH ROAD LA 34257 DATABLE SHERDS = 24
5.0
22.5
10.0
2.5
47.5
12.5
CERAMIC PROXIMITY, NORTH ROAD LA 34264 DATABLE SHERDS = 40
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
CERAMIC TYPE MIDPOINTS
725AD 2.09
775AD 4.01
787.5AD 2.04
800AD 6.02
812.5 5.05
837.5AD 4.02 1.02 1.05
850AD 6.04
875AD 1.04
900AD 4.03 1.06
4.06 912.5
937.5AD 1.07 5.02
3.02 950AD
975AD 2.05
987.5AD 1.09
1025AD 2.06
1062.5AD 5.04
1087.5 2.08 4.05
1100AD 3.05
1102.5AD 6.01 6.06 6.07
1112.5AD 4.07 1.08 5.03
1137.5AD 6.08 7.08 7.06
1150AD 3.03
1162.5AD 7.01
1175AD 1.10
1187.5AD 7.02
1225AD 5.06 6.03
1250. AD 6.09
1305AD 3.04


EARLY
MIDDLE
LATE
50%
25%
To 66%
17.0
2.1
6.4
8.5
CERAMIC PROXIMITY, SOUTH ROAD LA 34210 DATABLE SHERDS = 47
1.8
3.5
7.0
14.0
1.8
28.1
19.3
22.8
1.8
CERAMIC/LITHIC DIRECT, PENASCO BLANCO TO AHSHISLEPAH ROAD LA 34324 DATABLE SHERDS = 57
To 78.1%
3.1
6.3
3.1
12.5
CERAMIC DIRECT, PENASCO BLANCO TO AHSHISLEPAH ROAD LA 34310 DATABLE SHERDS =32
To 76.1%
4.5
7.5
9.0
1.5
1.5
CERAMIC/LITHIC DIRECT, SOUTH ROAD LA 34224 DATABLE SHERDS = 67
To 70.8%
20.8
4.2
4.2
CERAMIC DIRECT, SOUTH ROAD LA 34226 DATABLE SHERDS = 24
30.4
17.4
17.4
13.0
8.7
8.7
4.3
CREDIBILITY GAP HERRADURA, SOUTH ROAD LA 34233 DATABLE SHERDS = 23
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
CERAMIC TYPE MIDPOINTS
725AD 2.09
775AD 4.01
787.5AD 2.04
800AD 6.02
812.5 5.05
837.5AD 4.02 1.02 1.05
850AD 6.04
875AD 1.04
900AD 4.03 1.06
4.06 912.5
937.5AD 1.07 5.02
3.02 950AD
975AD 2.05
987.5AD 1.09
1025AD 2.06
1062.5AD 5.04
1087.5 2.08 4.05
1100AD 3.05
1102.5AD 6.01 6.06 6.07
1125AD 4.07 1.08 5.03
1137.5AD 6.08 7.08 7.06
1150AD 3.03
1162.5AD 7.01
1175AD 1.10
1187.5AD 7.02
1225AD 5.06 6.03
1250. AD 6.09
1305AD 3.04

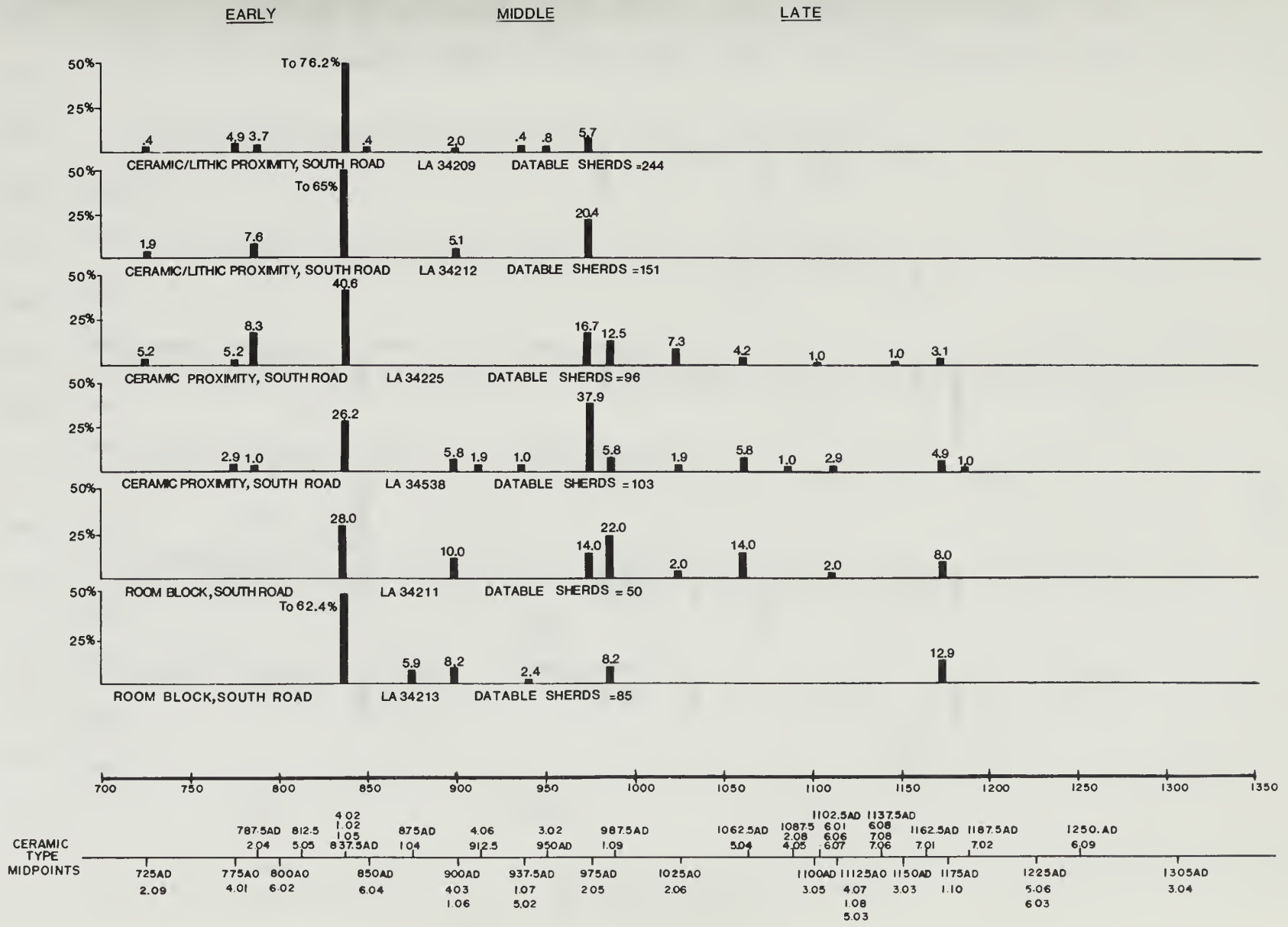

EARLY
MIDDLE
LATE
50%
25%
To 76.2%
.4
4.9
3.7
.4
2.0
.4
.8
5.7
CERAMIC/LITHIC PROXIMITY, SOUTH ROAD
LA 34209
DATABLE SHERDS =244
To 65%
1.9
7.6
5.1
20.4
CERAMIC/LITHIC PROXIMITY, SOUTH ROAD
LA 34212
DATABLE SHERDS =151
40.6
5.2
5.2
8.3
16.7
12.5
7.3
4.2
1.0
1.0
3.1
CERAMIC PROXIMITY, SOUTH ROAD
LA 34225
DATABLE SHERDS =96
37.9
26.2
2.9
1.0
5.8
1.9
1.0
5.8
1.9
5.8
1.0
2.9
4.9
1.0
CERAMIC PROXIMITY, SOUTH ROAD
LA 34538
DATABLE SHERDS =103
28.0
22.0
14.0
10.0
2.0
14.0
2.0
8.0
ROOM BLOCK, SOUTH ROAD
LA 34211
DATABLE SHERDS = 50
To 62.4%
5.9
8.2
2.4
8.2
12.9
ROOM BLOCK, SOUTH ROAD
LA 34213
DATABLE SHERDS =85
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
CERAMIC TYPE MIDPOINTS
725AD 2.09
775AO 4.01
787.5AD 2.04
800AO 6.02
812.5 5.05
837.5AD
4.02 1.02 1.05
850AD 6.04
875AD 1.04
900AD 4.03 1.06
4.06 912.5
937.5AD 1.07 5.02
3.02 950AD
975AD 2.05
987.5AD 1.09
1025AO 2.06
1062.5AD 5.04
1087.5 2.08 4.05
1100AD 3.05
1102.5AD 6.01 6.06 6.07
1125AO 4.07 1.08 5.03
1137.5AD 6.08 7.08 7.06
1150AD 3.03
1162.5AD 7.01
1175AD 1.10
1187.5AD 7.02
1225AD 5.06 6.03
1250.AD 6.09
1305AD 3.04

FIGURE 9-14, PAGE 8

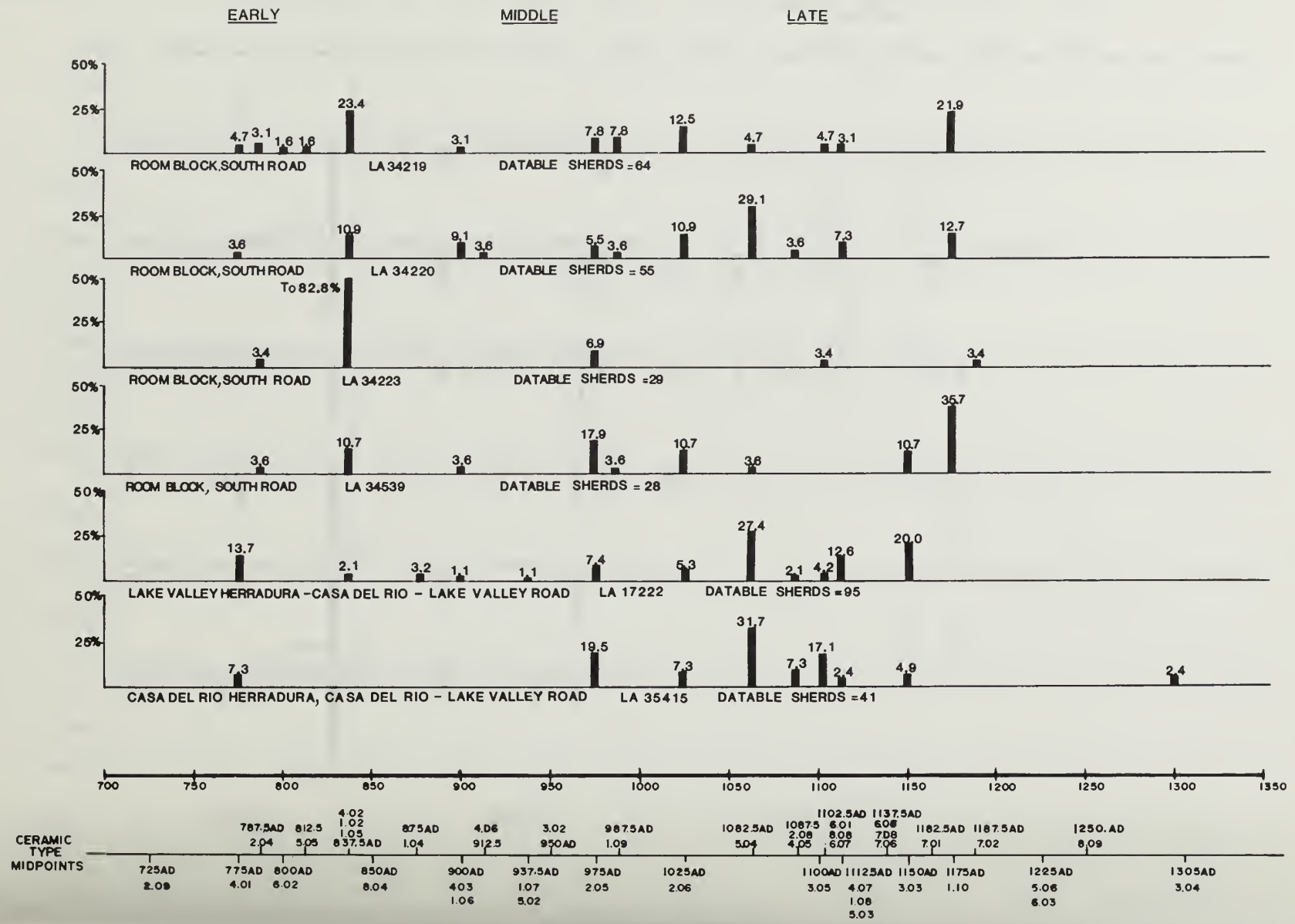
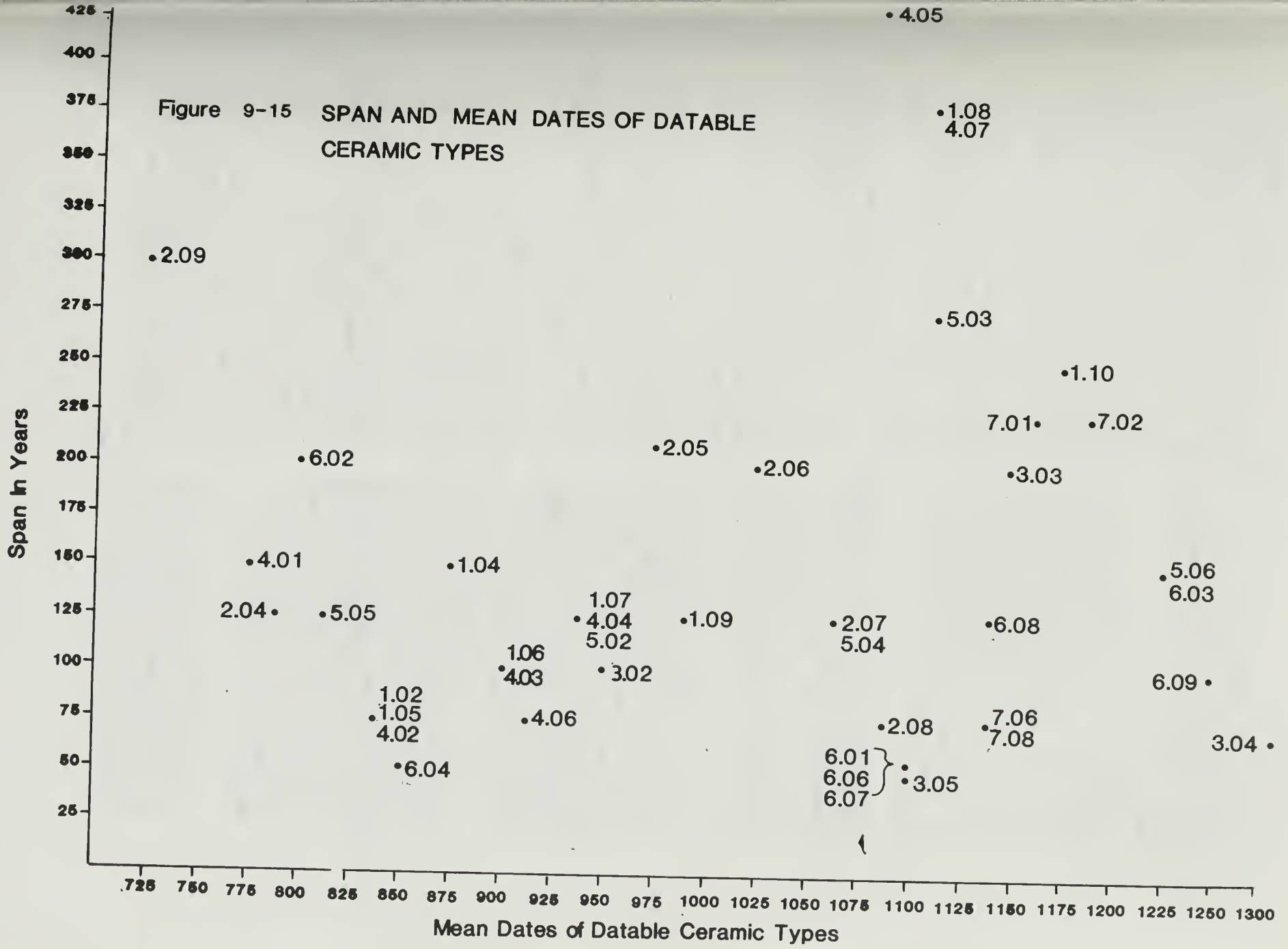


Figure 9-15 SPAN AND MEAN DATES OF DATABLE CERAMIC TYPES



for these wares. These conventions were followed for this project to preserve compatibility with the results of other research. However, it is important that the reader understand these biases as they will affect interpretations made later in this chapter.

Most investigators have followed two major conventions in field ceramic analysis of Mesa Verde Wares. These are represented schematically in Figure 9-16. The first concerns the affiliation of mineral- and carbon-painted decorated wares. Given the inability to consistently identify andesite temper, early Mesa Verdean mineral-painted wares (primarily Cortez and Mancos B/W dating between 950 and 1100 AD) have occasionally been lumped with mineral-painted Cibolan types (Red Mesa, Escavada and Gallup B/W). Thus, mineral paint Mesa Verde intrusives may be under-represented in ceramic assemblage counts.

Conversely, carbon-painted decorated white wares are often assumed to be Mesa Verdean. Researchers now believe that a significant percentage of these are of local origin (i.e., Cibolan) and should actually be referred to as "Chaco/McElmo." Classification of carbon-painted white wares as McElmo B/W has probably resulted in the over-representation of these later Mesa Verde intrusives.

The second convention which has been previously followed concerns the identification of Mesa Verde plain wares. Without variability in slip, paint or design elements to aid in identification, the recognition of these types rests solely on the presence of andesite temper. Given the difficulty in recognizing this temper in the field, these wares have probably consistently been counted as Cibolan plain wares for both early and later periods. Thus Mesa Verde plain wares have probably been consistently under-represented (or not represented at all) in ceramic assemblage counts.

Chuska. A second primary category of intrusive wares consisted of trachyte-tempered wares of Chuskan affinity. Both decorated and utility wares are represented in this category. Style horizons are again consistent with the Eastern Anasazi province as a whole. Chuska wares are tempered with a characteristic trachyte basalt (Loose 1977, Toll 1981) which can be consistently identified in the field with the naked eye. Style horizons within the Chuska series are similar between carbon- and mineral-painted wares. Paint type, however, was generally not monitored, due to an emphasis in the attribute analysis on temporal style.

White Mountain Red Wares. The third major category of intrusive wares is White Mountain Red wares which originate in the upper Little Colorado River Valley. In the San Juan Basin, red ware types include Puerco Black-on-Red, Wingate Black-on-Red, Wingate Polychrome and St. John's Polychrome. Puerco and Wingate Black-on-Red correspond stylistically to Escavada or solid styles and Gallup or hatchured styles. In the San Juan Basin these styles are represented primarily by large shallow bowls and are easily recognized as sherds by the presence of large crushed sherd temper, blood-red slip, fine polish and buff to grey paste. White Mountain Red wares occur consistently in late assemblages in the Basin floor in low frequencies of three percent or less. The presence of even a small amount of White Mountain Red ware in an assemblage suggests a date to the first quarter of the twelfth century or later (Windes and Cameron 1981:2).

Other intrusive ceramics occur in small numbers in assemblages in the Basin floor. These include San Juan Red wares of the Mesa Verde and Chuska series, Tsegi Orange Wares of the Kayentan school, Tusayan White wares of the Kayentan school (Marshall et al. 1979), Socorro B/W and polished, smudged brown wares.

Lithic Analysis. Analytical procedures followed for lithic data were relatively simple. The kinds of information needed were related primarily to the assessment of general types of activities taking place on the sites and to the presence of intrusive material types. Variability in the lithic data itself was rather limited; there were few lithic sites on two of the three roads examined, and artifact counts were low on all roads.

As stated earlier, all information on lithic variability was recorded in the field; no collections were made. Information collected included: amount of fire-cracked rock, amount and type of ground stone, number and type of formal tools, and degree of reduction and material type for flaked stone. Recording procedures varied somewhat according to site context.

During analysis, recorded information was sorted into site functional groups based on type of road-site association and site configuration. Material culture scatters having lithic assemblages were sorted into those sites Directly Associated with the road and those sites in Simple Physical Proximity to the road. Lithic, Lithic/Ceramic and Ceramic/Lithic groups were recognized within these two major categories. Lithic data was not integrated into the computer analysis of ceramic information; rather it was simply tabulated and summarized. Certain types of lithic material were recognized as intrusive: Washington Pass chert, source area in the Chuska Mountains; Chinle chert, source area unknown but presumed to be in the Zuni area; Brushy Basin chert, source area in the Four Corners area; Grants obsidian, source area in the Grants Ridge above Grants; Jemez obsidian, source area in the Jemez Mountains; and Red Hill obsidian, from near Quemado. Petrified woods and Pedernal-like chalcedony, in combinations with small quantities of quartzites from the Ojo Alamo formation, were presumed to be of local origin.

Mesa Verdean Wares	Bias	Cibolan Wares
White wares:		
Early (Pre-1100) Predominantly mineral paint, Cortez and Mancos types.	 Early mineral-painted types could have been Mesa Verdean (Mancos or Cortez) but have generally been called Cibolan (Red Mesa, Escavada or Gallup). This results in the under-representation of Mesa Verdean types for this time period.	Early (Pre-1100) Mineral paint, Red Mesa, Escavada and Gallup types.
Late (1100-1125) Predominantly carbon paint, Mesa Verde/ McElmo type.	 Late carbon-painted types could have been Cibolan (Chaco/McElmo) but have generally been called Mesa Verdean (Mesa Verde/McElmo). This results in the over-representation of Mesa Verdean types for this time period.	Late (1100-1125) Predominantly carbon paint, Chaco/McElmo type.
Plain wares All types.	 Andesite temper frequently missed, causing Mesa Verdean types to be lumped with Cibolan types. This results in the under-representation of Mesa Verdean types.	Plain wares All types.

Figure 9-16. Schematic Representation of the Biases Traditionally Introduced by Classification Errors for Mesa Verdean and Cibolan Ceramics

Presentation of Results

The results of data analysis are presented in a series of summary tables and figures. Detailed information concerning assemblage composition, Weighted Ceramic mean dates (including standard deviation and inter-quartile range), local and intrusive jar:bowl ratios, percent utility ware, percent intrusive ware, and lithic variability is contained in Tables 9-6 through 9-10. The percent of assemblage by road corridor for each ceramic type is shown in Figure 9-17.

Figures 9-18 through 9-21 graphically depict some of the more important analysis results. Jar:bowl ratios, percent utility ware, percent intrusive ware and mean dates are presented in a format intended to facilitate visual comparison between functional and road groupings. Additional tables and figures are introduced throughout the text.

Dating. Analysis of grouped sites within the individual road corridors shows that the South Road generally dates to around the early 900s, while the North and Penasco Blanco to Ahshislepah Roads both date to the late 1000s. Of the three roads, both the standard deviation and inter-quartile range of the Weighted Ceramic Mean date are smallest on the North Road overall (37 and 41 years respectively), indicating a fairly tight clustering of dates for sites in this corridor (see Table 9-6 and Figure 9-18). On the South Road, however, the standard deviation and inter-quartile range are much larger (81 and 142 years), indicating a broader dispersion of mean dates. This same pattern is noted for the Weighted Ceramic Ending dates of sites in the South Road corridor, but not for Weighted Ceramic Beginning dates (see Table 9-6). Interestingly, the latest type of site in this corridor is the Herradura (predicted earlier to be a road-associated type), with a Weighted Ceramic Mean date of 1044 AD.

As noted earlier, mean dates tend to mask information concerning the span of dates represented and the variabilty in frequencies of ceramic types of different dates. This variability was examined through the use of ceramic frequency graphs, which display the frequency of ceramic types present in an assemblage against the mean date of those types. Ceramic frequency graphs for a number of sites are presented in Figure 9-14.

In examining these graphs, four general patterns or "prototypes" were noted which are shown in stylized form in Figure 9-22. These prototypes appeared within three major arbitrarily defined time periods: "early" (775-900 AD), "middle" (900-1050 AD), and "late" (1050-1200 AD). They are described as follows:

Type I - Seen at Casa Patricio; characterized by high counts of early period, ceramics, and low counts of middle and late period ceramics.

Type II - Seen at Lower Greenlee and Upper Kin Klizhin; characterized by high counts of early period ceramics, with moderate peaks of both the middle and late period ceramics.

Type III - Seen at Chacra Face, Casa del Rio and Greenlee; characterized by early types present in small amounts, with middle and late types exhibiting low to moderate concentrations.

Type IV - Seen at Pierre's Acropolis A and B, Kin Indian, Kin Ya'a, Lake Valley, Los Aguages, Bee Burrow, Kimbeto Point, El Faro, and Tse Lichii; characterized by few or no early or middle period types, with substantial amounts of later types.

Once consistent patterns were recognized, additional ceramic frequency graphs were prepared for sites having larger material culture assemblages. In general, it was possible to roughly sort these graphs into one of the previously identified prototypes. Table 9-11 summarizes the distribution of all sites analyzed with respect to the type of pattern projected for the ceramic frequency graphs.

Although not quantitatively precise, these results indicate that there appears to be a late component to the South Road, detectable on at least some of the sites along the corridor. Sites which have probably been "impacted" by the road (i.e., which show higher frequencies for later period ceramics), include a wide variety of functional site types, from Bonito Style structures to Ceramic scatters. In general the late component does not appear to have been substantial enough to affect the other material culture traits under analysis (jar:bowl ratios, percent utility ware, etc.). A possible exception to this is the high "road-related" jar:bowl ratios present for Ceramic/Lithic Direct and Ceramic Direct groups, which appear as anomalies against the lower values for other sites in this corridor.

Jar:Bowl Ratios. Jar:bowl ratios for roads and functional groups by ceramic type are presented in Table 9-7. For easier interpretation, ratios for intrusive and local wares are graphically depicted in Figure 9-19. A number of conclusions can be drawn from this information. First, a consistent trend is seen towards low jar:bowl ratios for intrusive wares (Mesa Verde, Chuska and various red wares) and high jar:bowl ratios for local wares, suggesting either that intrusive wares were not being used to transport trade items along the roads, or that large numbers of intrusive bowls were being imported. Differences in the degree of "localness" of Cibola White ware may complicate this interpretation. Clearly for some areas on the North and Penasco Blanco to Ahshislepah Roads "intrusive" Mesa Verde and Chuska wares may be more "local" than Cibolan wares. Future studies should be conducted in which these factors are controlled for more carefully.

TABLE 9-6

WEIGHTED CERAMIC DATES FOR ROADS AND FUNCTIONAL GROUPS

	WCB[1]	SD (IQR)[2]	WCE[3]	SD (IQR)	WCM[4]	SD (IQR)	MIN[5]	SD (IQR)	MAX[6]	SD (IQR)
By Road										
North	1049	54 (82)	1139	46 (44)	1094	37 (41)	998	112 (212)	1153	59 (38)
Penasco Blanco to Ahshislepah	1069	68 (102)	1141	78 (55)	1097	75 (88)	1025	111 (175)	1136	86 (88)
South	847	80 (73)	1014	98 (176)	931	81 (142)	813	71 (63)	1141	92 (13)
By Function										
Zambullida	1022	51 (72)	1098	35 (50)	1060	43 (61)	1006	27	1150	0
Herradura	946	43 (84)	1151	10 (18)	1049	23 (42)	816	49	1195	74
Bonito Style	953	97 (175)	1111	71 (73)	1032	79 (118)	854	95	1168	48
Lithic/Ceramic Direct	1059	75 (106)	1144	44 (63)	1102	15 (22)	994	168	1131	27
Ceramic/Lithic Direct	1010	84 (70)	1124	84 (67)	1067	80 (25)	899	124	1207	72
Ceramic Direct	1040	91 (100)	1160	68 (42)	1100	63 (86)	996	99	1166	57
Roomblock	838	43 (83)	1044	79 (145)	941	58 (125)	802	27	1177	5
Lithic/Ceramic Proximity	1032	64 (90)	1124	1 (2)	1073	24 (44)	1000	108	1108	44
Ceramic/Lithic Proximity	975	110 (209)	1080	114 (136)	1028	104 (114)	929	157	1112	93
Ceramic Proximity	917	137 (275)	1032	87 (142)	974	110 (208)	896	147	1131	71
Avanzada	1043	105 (82)	1113	29 (28)	1078	65 (45)	1025	110	1139	20
By Road - By Function										
North Road										
Zambullida										
Herradura										
Bonito Style	1011	32 (57)	1151	11 (20)	1081	15 (28)	888	103	1150	0
Lithic/Ceramic Direct	1059	75 (106)	1144	44 (63)	1102	15 (22)	994	168	1131	27
Ceramic/Lithic Direct	1034	44 (76)	1148	42 (68)	1091	32 (22)	928	122	1208	80
Ceramic Direct	1074	59 (113)	1212	106 (197)	1143	71 (142)	996	109	1193	100
Roomblock										
Lithic/Ceramic Proximity	1032	64 (90)	1124	1 (2)	1073	24 (44)	1000	108	1108	44
Ceramic/Lithic Proximity	1018	72 (82)	1128	60 (57)	1073	47 (51)	980	130	1144	71
Ceramic Proximity	1081	20 (37)	1126	15 (30)	1104	14 (28)	1067	36	1138	22
Avanzada	1075	46 (57)	1121	17 (29)	1098	28 (31)	1056	62	1138	21

TABLE 9-6 (Concluded)

	WCB[1]	SD[2] (IQR)[7]	WCE[3]	SD (1QR)	WCM[4]	SO (1QR)	MIN[5]	SO (1QR)	MAX[6]	SO (IQR)
Penasco Blanco to Ahshislepah Road										
Zambullida	1058		1123		1090		1024		1150	
Herradura										
Bonito Style										
Lithic/Ceramic Direct										
Ceramic/Lithic Direct	1033		1149		1091		775		1225	
Ceramic Direct	1070	64 (121)	1133	14 (26)	1102	38 (73)	1041	84	1141	19
Roomblock										
Lithic/Ceramic Proximity										
Ceramic/Lithic Proximity										
Ceramic Proximity	988		1072		1030		974		1063	
Avanzada										
South Road										
Zambullida										
Herradura	928		1161		1044		838		1175	
Bonito Style	926	140 (257)	1063	99 (175)	995	114 (212)	853	130	1169	16
Lithic/Ceramic Direct										
Ceramic/Lithic Direct	798		908		853		788		1175	
Ceramic Direct	926	117 (166)	1136	39 (55)	1031	39 (55)	906	97	1175	0
Roomblock	838	43 (83)	1044	79 (145)	941	58 (125)	802	27	1177	5
Lithic/Ceramic Proximity										
Ceramic/Lithic Proximity	805	1 (1)	889	6 (9)	847	3 (4)	725	0	981	9
Ceramic Proximity	804	11 (20)	967	53 (79)	885	28 (43)	778	40	1140	92
Avanzada										

Notes: 1/ Weighted ceramic beginning date.
2/ Standard deviation.
3/ Weighted ceramic ending date.
4/ Weighted ceramic mean date.
5/ Minimum date.
6/ Maximum date.
7/ Inter-quartile range.

TABLE 9-7

CERAMIC INFORMATION FOR ROADS AND FUNCTIONAL GROUPS

	Jar:Bowl Ratios						Percent Utility			Percent Intrusives				
	All Decorated	Intrusive Decorated	Local Decorated	Mesa Verde	Chuska White Wares	White Mountain Red Ware	Total	Cibola	Chuska	Total	Mesa Verde	Chuska	White Mountain Red Ware	Other
By Road														
North	1.7	.4	3.8	.65	1.7	.1	49	45	4	20	9	5	5	1
Penasco Blanco to Ahshislepah	3	1.6	4.7	1.7	1.3		31	30	1	27	22	3	1	1
South	1.7	.7	1.8	.65	2.5	.4	65	62	3	8	1	4	1	2
By Function														
Zambullida	4.2	1	8.6	1			43	36	6	18	10	7	1	
Herradura	1.9	.5	3	.5	2	1	32	22	10	27	10	13	1	3
Bonito Style	2	1.1	2.4	2.7	1	1.5	63	59	4	11	3	5	1	2
Lithic/Ceramic Direct							74	74		22	22			
Ceramic/Lithic Direct	1.8	.6	4.2	1.3	1.1		42	40	2	23	11	4	6	2
Ceramic Direct	1.6	.9	2.4	.7			48	46	2	20	14	2	3	1
Roomblock	1.5	.9	1.6		2.5	1	63	59	4	9	1	6	1	1
Lithic/Ceramic Proximity	1.5	.5	2.2	1			42	42		13	9		2	2
Ceramic/Lithic Proximity	2.1	.6	2.5	.4	2		65	60	5	9	2	7	T	T
Ceramic Proximity	1.9	1.3	2	.6			59	51	8	12	2	9	1	T
Avanzada	1.5	.8	1.6	.6	1.5	.7	44	28	16	25	5	18	2	T
By Road - By Function														
North Road														
Zambullida														
Herradura														
Bonito Style	2.4	.9	3.7	.7			73	69	4	11	6	4	1	
Lithic/Ceramic Direct							74	74		22	22			
Ceramic/Lithic Direct	1.5	.4	3.8	.9	1		41	39	2	23	10	3	8	2
Ceramic Direct	3	1.3	6.5	.8			36	32	4	28	16	4	6	2
Roomblock														
Lithic/Ceramic Proximity	1.5	.5	2.2	1			42	42		13	9		2	2
Ceramic/Lithic Proximity	2.6	.5	6.5	.3	2		57	45	12	24	6	16	1	1
Ceramic Proximity	2.6	.4	6.2	.3			56	50	6	15	7	7	1	
Avanzada	2	.7	2.7	.4		.7	46	39	7	17	6	7	3	1
Penasco Blanco to Ahshislepah Road														
Zambullida	4.2	1	8.6	1			40	39	1	17	15	1	1	
Herradura														
Bonito Style														
Lithic/Ceramic Direct														
Ceramic/Lithic Direct	4.1	2.6	6.6	3.3	1.3		19	18	1	37	28	7		2
Ceramic Direct	.8	.6	1	.6			47	45	2	27	22	2	3	
Roomblock														
Lithic/Ceramic Proximity														
Ceramic/Lithic Proximity														
Ceramic Proximity	3.5		3							11	11			
Avanzada														

TABLE 9-7 (Concluded)

	Jar:Bowl Ratios						Percent Utility			Percent Intrusives				
	All Decorated	Intrusive Decorated	Local Decorated	Mesa Verde	Chuska White Wares	White Mountain Red Ware	Total	Cibola	Chuska	Total	Mesa Verde	Chuska	White Mountain Red Ware	Other
South Road														
Zambullida														
Herradura	1.1	.3	2.3	.4			27	27		26	23		3	
Bonito Style	2.1	1	2.5	1.4	2	1	67	66	1	7	2	2	1	2
Lithic/Ceramic Direct														
Ceramic/Lithic Direct	3.7		5.5				77	77		7	1	6		
Ceramic Direct	4		4				65	65						
Roomblock	1.5	.9	1.6		2.5	1	63	59	4	9	1	6	1	1
Lithic/Ceramic Proximity														
Ceramic/Lithic Proximity	1.9	1	1.9	1	2		68	65	3	4	T	4		T
Ceramic Proximity	1.7	4.5	1.6				60	52	8	12	T	10	1	1
Avanzada														

TABLE 9-8

ASSEMBLAGE COMPOSITION FOR ROADS AND FUNCTIONAL GROUPS

	Cibola Utility		Cibola White Ware		Mesa Verde		Chuska Utility		Chuska White Ware		White Mountain Red Ware		Other			
	Number[a]	Percent[b]	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Sherd	Total Components
By Road																
North	692	45	548	35	136	9	63	4	16	1	74	5	19	1	1,548[c]	
Penasco Blanco to Ahshislepah	90	30	131	43	68	22	3	1	7	2	3	1	3	1	305[c]	
South	1,474	62	713	30	31	1	70	3	29	1	16	1	29	1	2,362[c]	
By Function																
Zambullida	68	36	86	46	19	10	12	6	1	T	1	T			187	3
Herradura	68	22	163	52	33	10	30	10	10	3	4	1	8	3	316	4
Bonito Style	1,013	59	517	30	46	3	72	4	15	1	14	1	40	2	1,717	14
Lithic/Ceramic Direct	17	74	1	4	5	22									23	2
Ceramic/Lithic Direct	381	40	359	37	110	11	16	2	20	2	58	6	17	2	961	11
Ceramic Direct	70	46	51	34	21	14	3	2			5	3	1	1	151	9
Roomblock	240	59	130	32	5	1	17	4	7	2	4	1	1	T	405	7
Lithic/Ceramic Proximity	19	42	20	44	4	9					1	2	1	2	45	6
Ceramic/Lithic Proximity	381	60	195	31	11	2	33	5	9	1	2	T	2	T	633	11
Ceramic Proximity	258	51	184	37	11	2	38	8	8	2	3	1	2	T	504	11
Avanzada	89	28	146	47	15	5	50	16	8	3	5	2	1	T	314	9
By Road - By Function																
North Road																
Zambullida																1
Herradura																
Bonito Style	139	69	42	21	12	6	7	4			2	1			202	4
Lithic/Ceramic Direct	17	74	1	4	5	22									23	2
Ceramic/Lithic Direct	291	39	292	39	75	10	15	2	8	1	58	8	14	2	753	9
Ceramic Direct	16	32	20	40	8	16	2	4			3	6	1	2	50	3
Roomblock																
Lithic/Ceramic Proximity	19	42	20	44	4	9					1	2	1	2	45	6
Ceramic/Lithic Proximity	69	45	48	31	9	6	18	12	6	4	3	2			153	9
Ceramic Proximity	64	50	44	35	9	7	8	6	1	1	1	1			127	5
Avanzada	69	39	78	44	11	6	12	7	1	1	5	3	1	1	177	8

TABLE 9-8 (Concluded)

	Cibola Utility		Cibola White Ware		Mesa Verde		Chuska Utility		Chuska White Ware		White Mountain Red Ware		Other			
	Number[a/]	Percent[b/]	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Sherd	Total Components
Penasco Blanco to Ahshislepah Road																
Zambullida	42	39	49	45	16	15	1	1			1	1			109	1
Herradura																
Bonito Style																
Lithic/Ceramic Direct																
Ceramic/Lithic Direct	22	18	53	44	34	28	1	1	7	6			3	3	120	1
Ceramic Direct	26	45	16	28	13	22	1	2			2	3			58	4
Roomblock																
Lithic/Ceramic Proximity																
Ceramic/Lithic Proximity																
Ceramic Proximity			8	89	1	11									9	1
Avanzada																
South Road																
Zambullida																
Herradura	8	27	14	47	7	23					1	3			30	1
Bonito Style	573	66	230	27	14	2	8	1	5	1	8	1	28	3	866	4
Lithic/Ceramic Direct																
Ceramic/Lithic Direct	68	77	14	16	1	1			5	6					88	1
Ceramic Direct	28	65	15	35											43	2
Roomblock	240	59	130	32	5	1	17	4	7	2	4	1	2	T	405	7
Lithic/Ceramic Proximity																
Ceramic/Lithic Proximity	312	65	147	31	2	T	15	3	3	1	1	T			48D	2
Ceramic Proximity	194	53	132	36	1	T	30	8	7	2	2	1	2	1	368	5
Avanzada																

a/ Total sherds analyzed.
b/ Percentage of total assemblage.
c/ Corridor totals include minor site types not included in the breakdown by functional groups.

TABLE 9-9

MATERIAL CULTURE SCATTERS - LITHIC DATA

	Size (M)	Sample Percent	Ceramic Count	Weighted Ceramic Mean Date	P/A Fire-Cracked Rock	P/A Ground Stone	Formal Tools	Function	Number of Flaked Stone Pieces: Total Flaked Stone	Chalcedony	Petrified Wood	Brushy Basin Chert	Quartzite	Washington Pass Chert	Other
North Road															
Lithic-Ceramic Direct															
LA 34279	143 X 50	100%	21	1091	A	A	Hammerstone (1)	Lithic Reduction	75	43	29		1		2
LA 34261		100%	2		A	A			5	1	3		1		
Ceramic-Lithic Direct															
LA 34258	60 X 60	60%	131	1080	A	A			8		7		1		
LA 34263	60 X 38	100%	70		A	A			5		3	1			1
LA 34265	150 X 30	100%	101	1085	A	A	Biface (1)		5	1	2		1		1
LA 34282	270 X 95	100% (Lithics Only)	159	1076	A	A			19	6	10		1		2
LA 34284	105 X 20	100% (Lithics Only)	167	1082	A	A			16	8	3			5	
LA 34286	25 X 30	100%	44	1161	A	A			7	2	4				1
LA 34289	175 X 30	100%	51	1101	A	A			2		2				
LA 34300	280 X 50	100%	93	1049	A	A			2						
LA 34253		100%	7		A	A			5	3	1		1		
Lithic Proximity															
LA 34272		100%			A	A			7		5		1		1
LA 34275		100%			A	A			14	4	10				
LA 34276		100%			A	A	Hammerstone		10	3	1		4		2
LA 34277		100%			A	A		Lithic Reduction	42		42				
LA 34302	50 X 100	100%			A	A			7						
LA 34266	25 X 70	100%			P	A		Tool Manufacture	113	62	45		6		
LA 34267	10 X 30	100%			P	A		Lithic Reduction	18	4	13	1			
LA 34273	150 X 50	100%		Archaic	P	P	Axe, Mano, Metate	Tool Manufacture	144						
#1	60 X 40				(P)	(P)	Misc. Flaked Stone Tools	Plant Processing Lithic Reduction	(73)	29	36		8		
#2	85 X 35				(P)	(P)			(71)	39	30		1		1
LA 34280	80 X 50	50%		Archaic	P	P	Flake Tools, Ground Stone, Knife, Point,	Lithic Reduction	40	5	32	2	1		
LA 34281	25 X 35	100%			P	P	Hammerstone, (1) Ground Stone	Plant Processing Lithic Reduction	21	6	12		3		
LA 34711	200 X 30				A	A									
LA 34718					A	P	Biface, Hammerstone Projectile Point	Plant Process							
Lithic Ceramic Proximity															
LA 34268	40 X 30	100%	27	1055	A	A		Lithic Reduction	48	18	25	1	2		2
LA 34269	60 X 20	100%	7		P	A			14	6	6	2			
LA 34270		100%			P	A			6	6					
LA 34711					P	P			48	47			1		
LA 34718					A	A									
LA 34722					A	A									
Ceramic/Lithic Proximity															
LA 34256	40 X 30	100%	10	1034	A	A			1		1				
LA 34257	150 X 30	25%	53	1063	A	A			2	1	1				
LA 34274	15 X 30	100%	6	1059	A	A			5	3	1		1		
LA 34283	30 X 10	100%	15	1170	A	A			8	2	6				
LA 34293	40 X 60	100%	22	1081	A	A			7	4	3				
LA 34254		100%	7		A	A	Chopper		4		2		2		
LA 34255		100%	12	1069	A	A			3		3				
LA 34271			28	1011	A	A			4		4				
LA 34721		100%	5		A	A			4		1		3		
Penasco Blanco To Ahshislepah Road															
Ceramic-Lithic Direct															
LA 34324	110 X 110	100%	120	1091	P	A			11	4	7				
Lithic Proximity															
LA 34330		100%			A	A			5	3					2
LA 34331	15 X 15	100%			A	A	Biface, Knife		7	3	4				
South Road															
Ceramic-Lithic Direct															
LA 34224	230 X 90		88	853	A	A			2					1	1
Ceramic-Lithic Proximity															
LA 34209	180 X 150		301	845	P	P	Projectile Points, Pendants, Flake Tools, Hammerstone		44	10	16		8	3	7
LA 34212	50 X 80		179	849	A	A			21	14	5			1	1

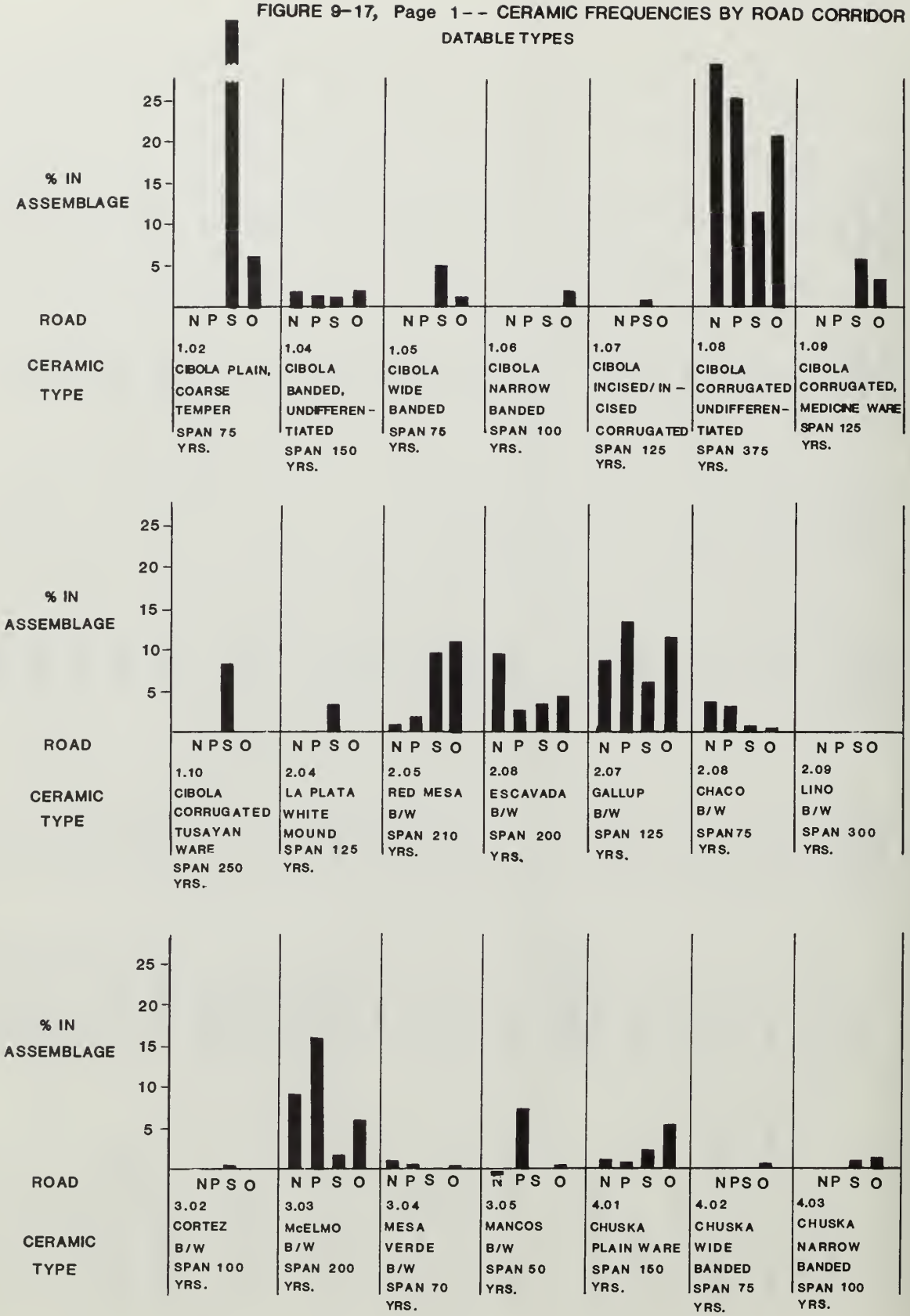
TABLE 9-10

RESULTS OF MATERIAL CULTURE ANALYSIS FOR MAJOR STRUCTURAL SITES

Site Name	Road Affiliation	Weighted Ceramic Mean Date	Marshall et al. Mean Date	Local J:B Ratio	Percent Utility Ware	Percent Intrusive Ware
Pierre's Acropolis A	North	1098	1103	1.5	73	20
Pierre's Acropolis B	North	1072	1103	-	85	6
Kin Indian Ruin	North	1065	1063	3.4	69	8
El Faro	North	1088	1103	-	69	7
Los Aguages	Penasco Blanco to Ahshislepah	1090	1063	8.6	39	17
Upper Kin Klizhin	South	947	1025	2.4	60	11
Casa Patricio	South	856	925	2.7	79	2
Bee Burrow	South	1093	1125	-	54	10
Kin Ya'a	South	1084	1063	-	75	3
Casa del Rio	Casa del Rio-Lake Valley	981	1038	-	52	30
Lake Valley	Casa del Rio-Lake Valley	1090	1138	-	54	43
Greenlee	Southeast	1007	1063	3.0	84	10
Lower Greenlee	Southeast	913	1038	1.5	59	6
Chacra Face	Chacra Face	1046	1038	-	47	6
Tse Lichii	Chacra Face	1110	1088	-	49	21
Kimbeto Point	Chaco North	1029	1088	-	47	19

FIGURE 9–17, Page 1 – – CERAMIC FREQUENCIES BY ROAD CORRIDOR

DATABLE TYPES


% IN ASSEMBLAGE
25
20
15
10
5
ROAD
CERAMIC TYPE
N P S O
1.02 CIBOLA PLAIN, COARSE TEMPER SPAN 75 YRS.
1.04 CIBOLA BANDED, UNDIFFEREN-TIATED SPAN 150 YRS.
1.05 CIBOLA WIDE BANDED SPAN 75 YRS.
1.06 CIBOLA NARROW BANDED SPAN 100 YRS.
1.07 CIBOLA INCISED/ IN – CISED CORRUGATED SPAN 125 YRS.
1.08 CIBOLA CORRUGATED UNDIFFEREN-TIATED SPAN 375 YRS.
1.09 CIBOLA CORRUGATED, MEDICINE WARE SPAN 125 YRS.
1.10 CIBOLA CORRUGATED TUSAYAN WARE SPAN 250 YRS.
2.04 LA PLATA WHITE MOUND SPAN 125 YRS.
2.05 RED MESA B/W SPAN 210 YRS.
2.08 ESCAVADA B/W SPAN 200 YRS.
2.07 GALLUP B/W SPAN 125 YRS.
2.08 CHACO B/W SPAN75 YRS.
2.09 LINO B/W SPAN 300 YRS.
3.02 CORTEZ B/W SPAN 100 YRS.
3.03 McELMO B/W SPAN 200 YRS.
3.04 MESA VERDE B/W SPAN 70 YRS.
3.05 MANCOS B/W SPAN 50 YRS.
4.01 CHUSKA PLAIN WARE SPAN 150 YRS.
4.02 CHUSKA WIDE BANDED SPAN 75 YRS.
4.03 CHUSKA NARROW BANDED SPAN 100 YRS.

KEY:

N – NORTH ROAD

P – PENASCO BLANCO TO AHSHISLEPAH ROAD

S – SOUTH ROAD

O – OTHER ROADS

FIGURE 9-17, Page 2

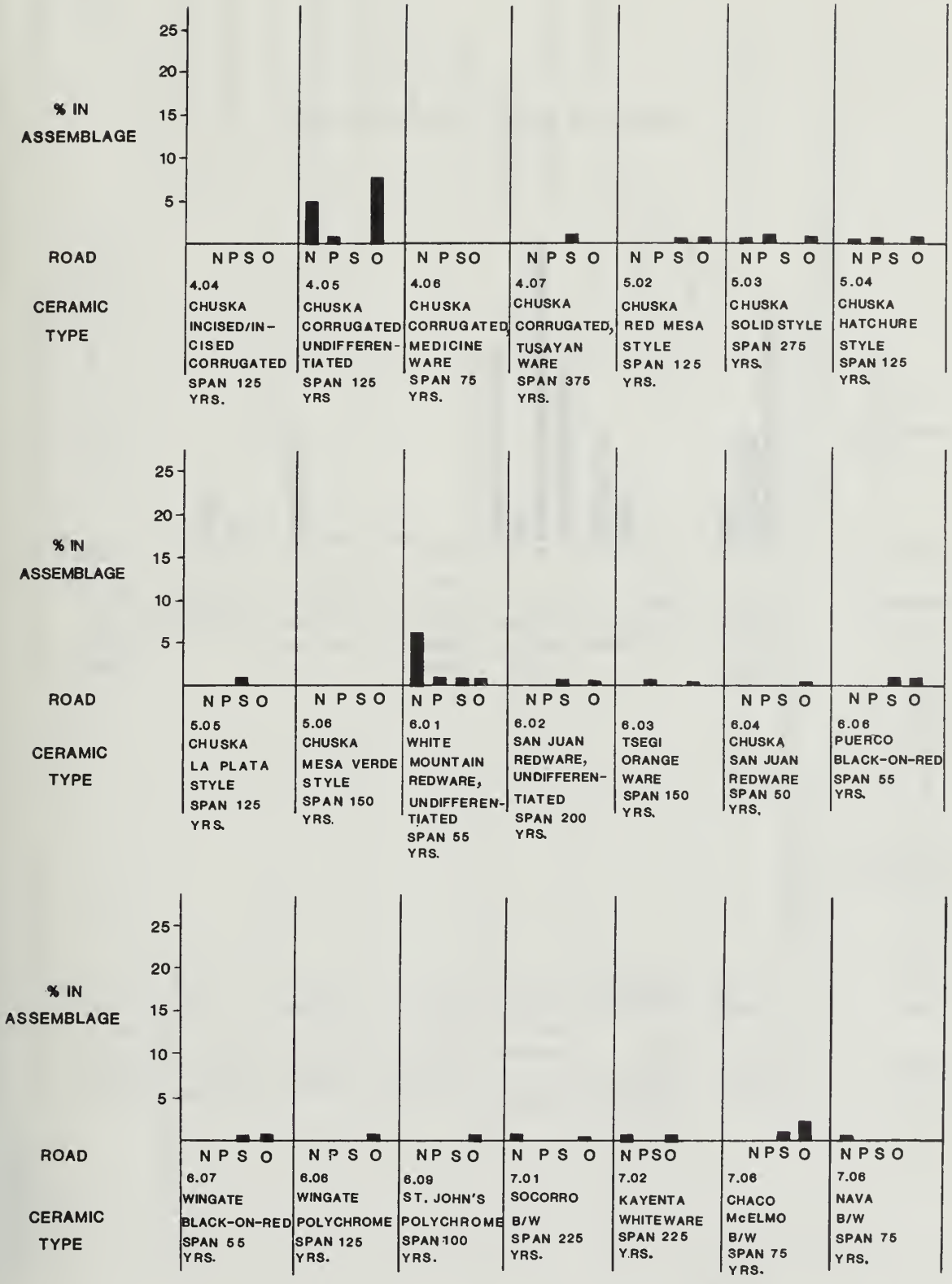

% IN ASSEMBLAGE
25
20
15
10
5
ROAD
CERAMIC TYPE
N P S O
4.04 CHUSKA INCISED/INCISED CORRUGATED SPAN 125 YRS.
4.05 CHUSKA CORRUGATED UNDIFFERENTIATED SPAN 125 YRS
4.06 CHUSKA CORRUGATED, MEDICINE WARE SPAN 75 YRS.
4.07 CHUSKA CORRUGATED, TUSAYAN WARE SPAN 375 YRS.
5.02 CHUSKA RED MESA STYLE SPAN 125 YRS.
5.03 CHUSKA SOLID STYLE SPAN 275 YRS.
5.04 CHUSKA HATCHURE STYLE SPAN 125 YRS.
5.05 CHUSKA LA PLATA STYLE SPAN 125 YRS.
5.06 CHUSKA MESA VERDE STYLE SPAN 150 YRS.
6.01 WHITE MOUNTAIN REDWARE, UNDIFFERENTIATED SPAN 55 YRS.
6.02 SAN JUAN REDWARE, UNDIFFERENTIATED SPAN 200 YRS.
6.03 TSEGI ORANGE WARE SPAN 150 YRS.
6.04 CHUSKA SAN JUAN REDWARE SPAN 50 YRS.
6.06 PUERCO BLACK-ON-RED SPAN 55 YRS.
6.07 WINGATE BLACK-ON-RED SPAN 55 YRS.
6.08 WINGATE POLYCHROME SPAN 125 YRS.
6.09 ST. JOHN'S POLYCHROME SPAN 100 YRS.
7.01 SOCORRO B/W SPAN 225 YRS.
7.02 KAYENTA WHITEWARE SPAN 225 YRS.
7.06 CHACO McELMO B/W SPAN 75 YRS.
7.06 NAVA B/W SPAN 75 YRS.

FIGURE 9-17, Page 3, UNDATABLE TYPES

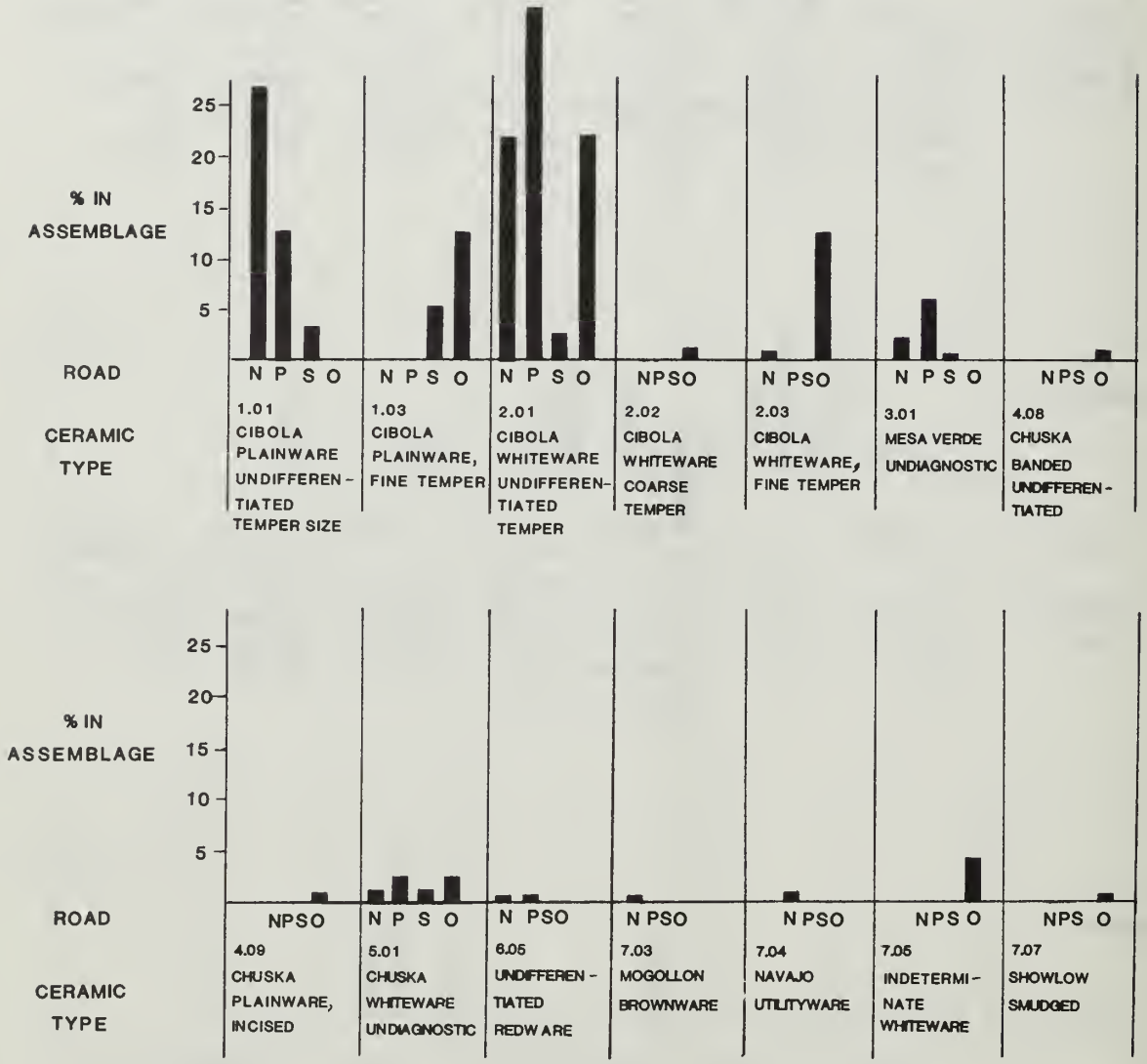


FIGURE 9-18 WEIGHTED CERAMIC MEAN DATES BY ROAD AND FUNCTIONAL GROUP

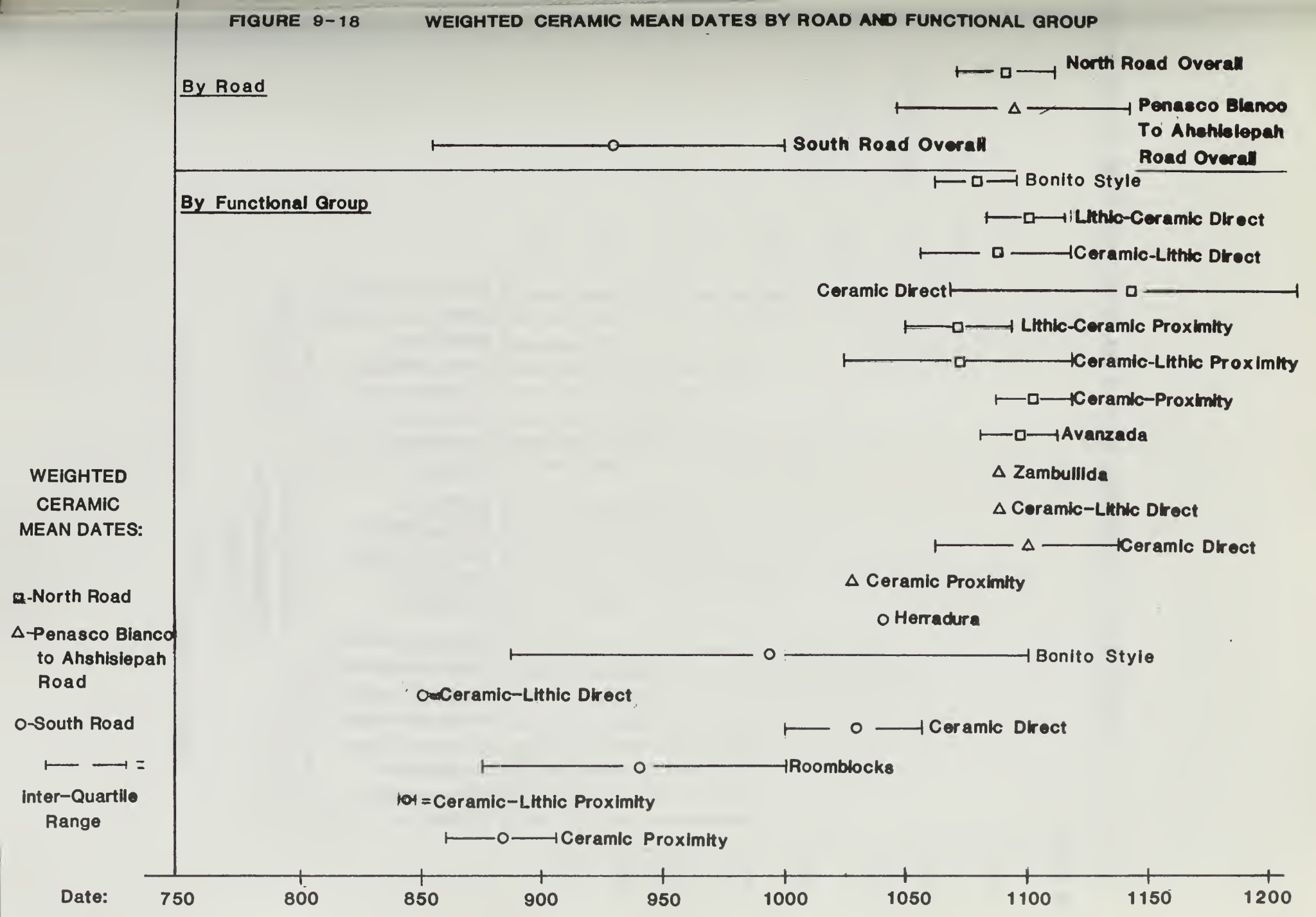


Figure 9-19 JAR:BOWL RATIOS BY ROAD AND FUNCTIONAL GROUP

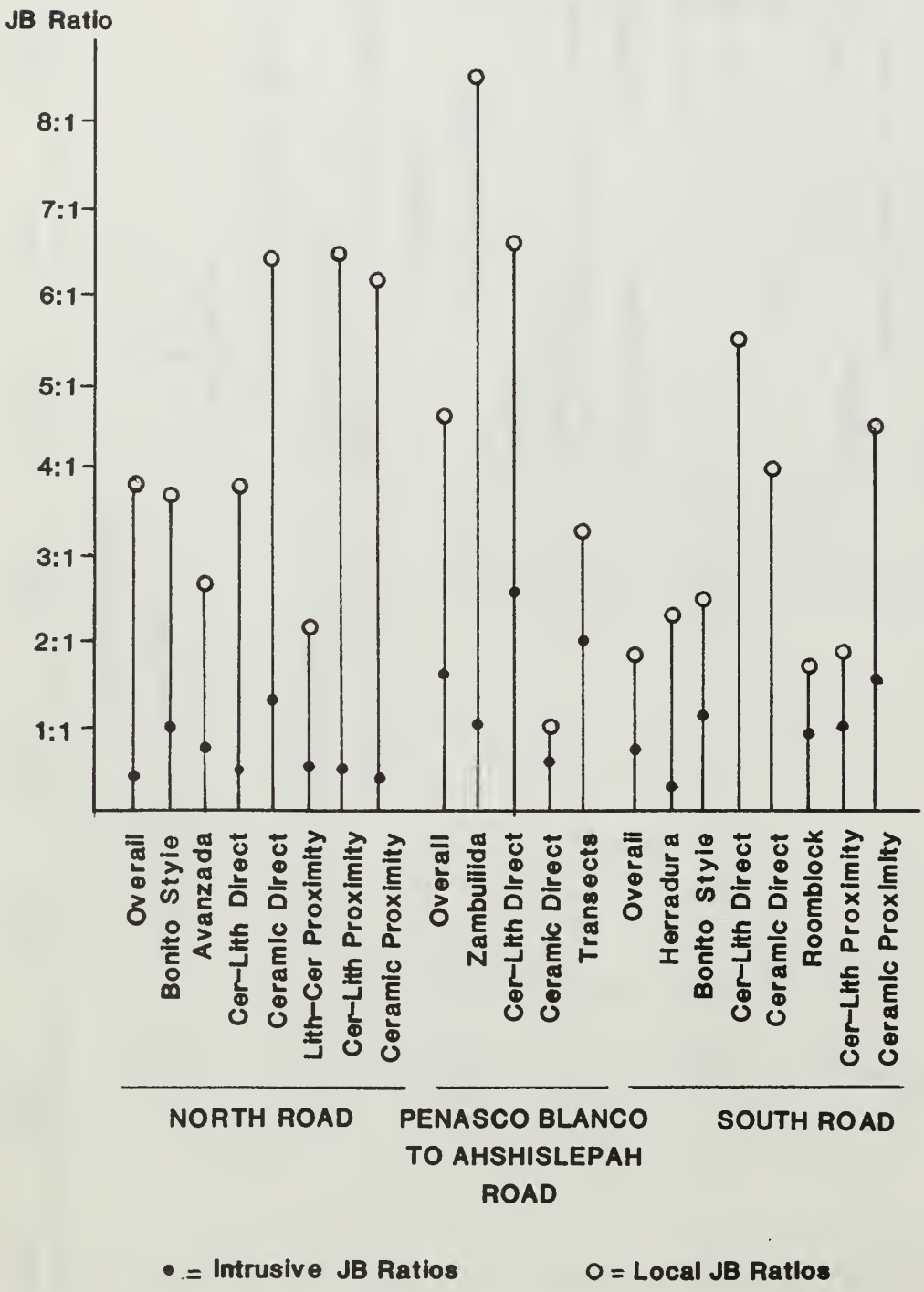


Figure 9-20 PERCENT UTILITY WARE BY ROAD AND FUNCTIONAL GROUPS

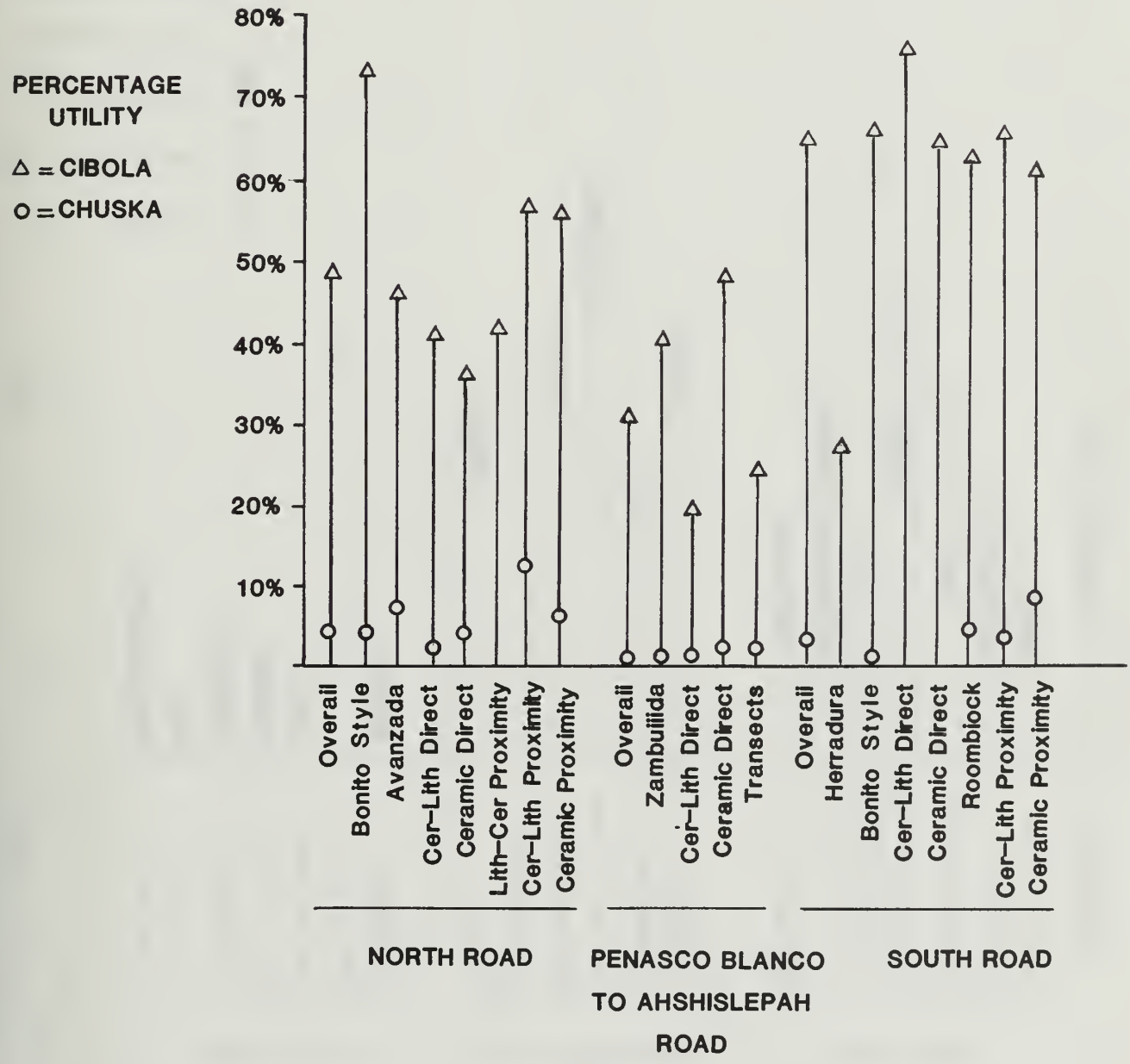


Figure 9-21 PERCENT INTRUSIVES BY ROAD AND FUNCTIONAL GROUP

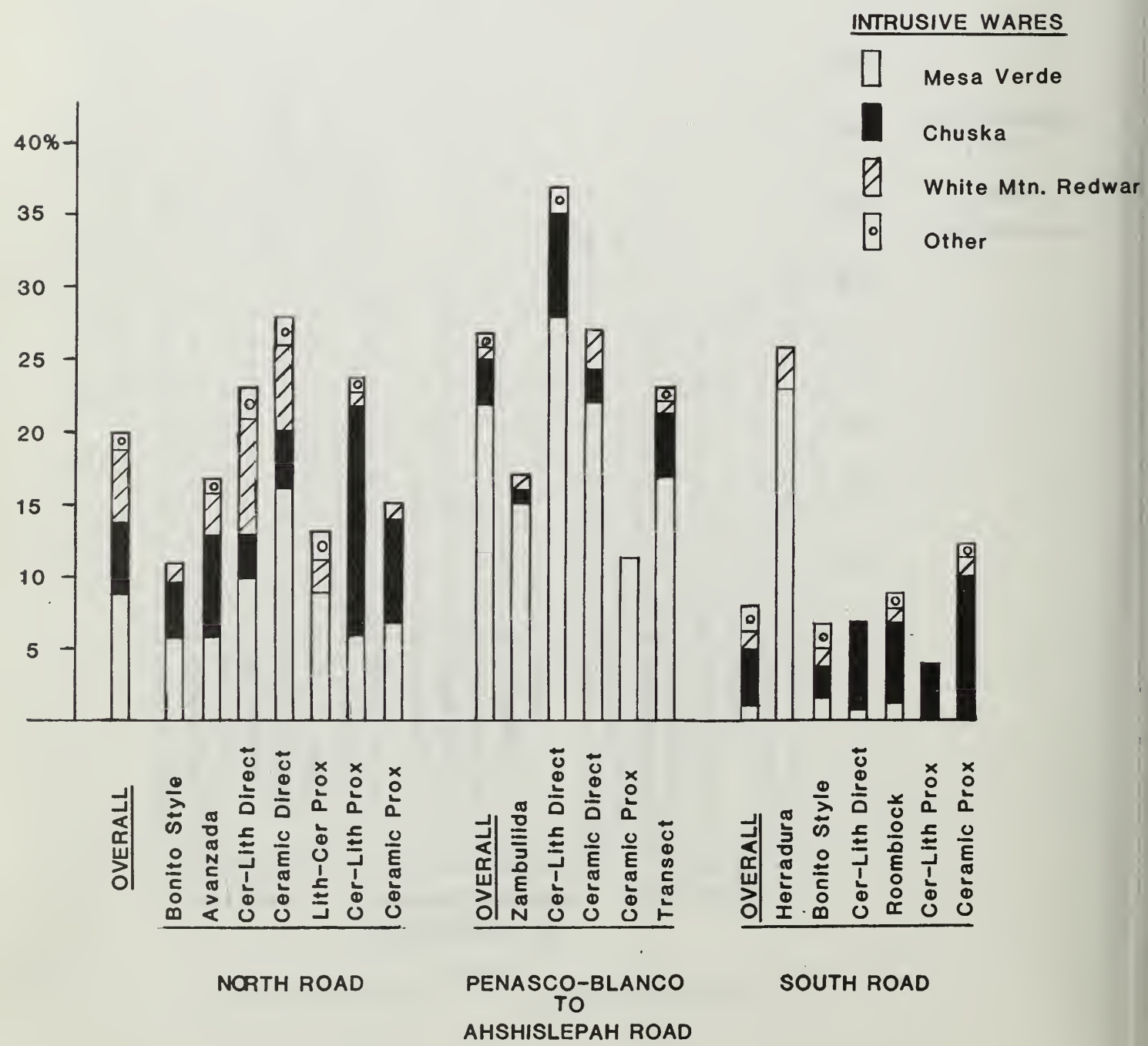


Figure 9-22 CERAMIC FREQUENCY PROTOTYPES

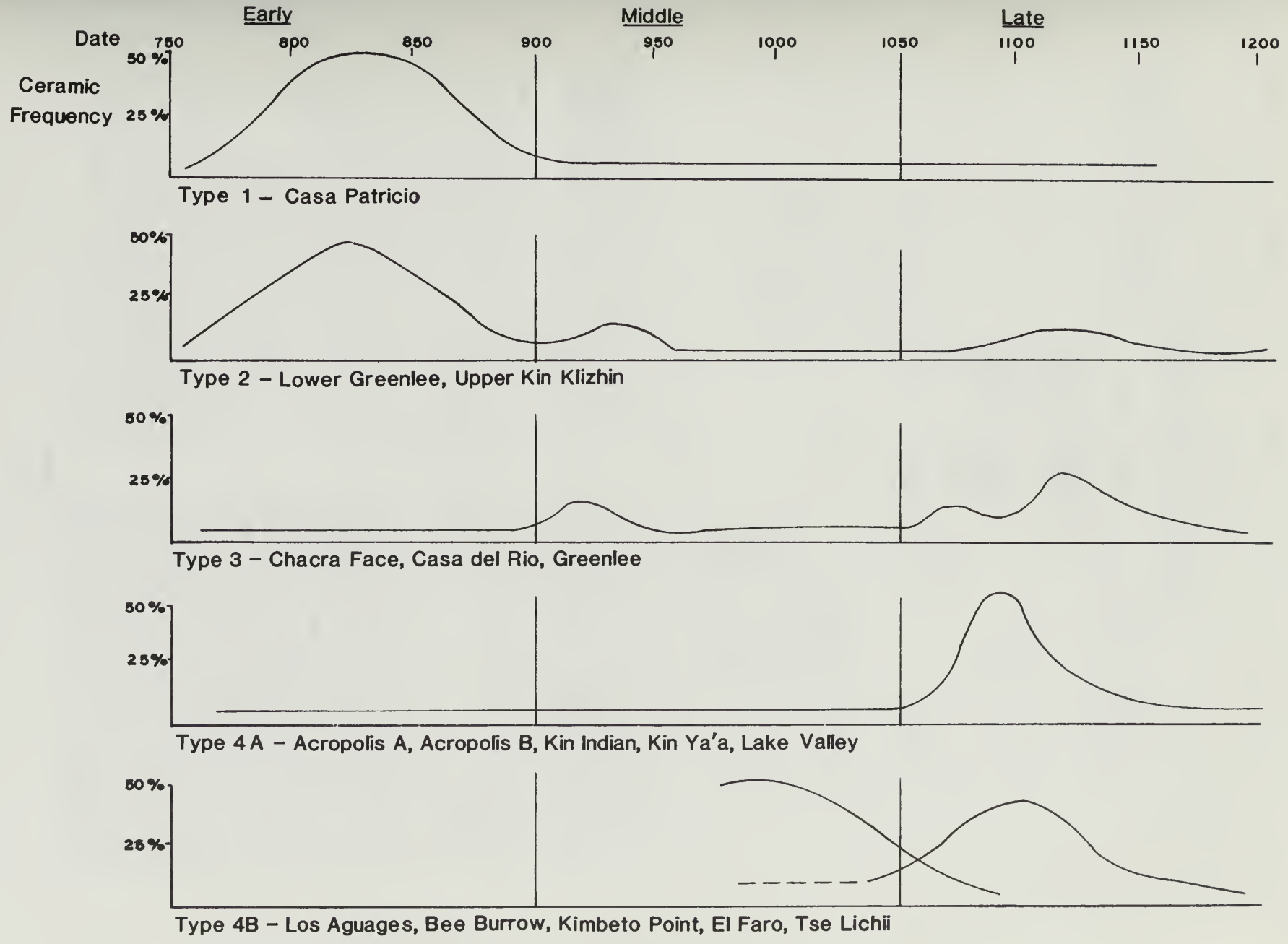


TABLE 9-11

DISTRIBUTIION OF SITES BY CERAMIC
FREQUENCY PROTOTYPE AND ROAD CORRIDOR

	North Road	South Road	Other Roads
Type 1		Casa Patricio LA 34210 LA 34224 LA 34209 LA 34212	
Type 2	LA 35416	Upper Kin Klizhin LA 34225 LA 34538 LA 34211 LA 34213 LA 34219 LA 34223 LA 34539	Lower Greenlee
Type 3		LA 34226 LA 34233 LA 34220	Chacra Face Ruin, Greenlee, Casa del Rio LA 17222 (Herradura)
Type 4	Acropolis A Acropolis B Kin Indian LA 16516 LA 34298 LA 34279 LA 34257 LA 34264 LA 34284 LA 34286 LA 34289 LA 34300 LA 34258 LA 34265 LA 34282	Bee Burrow Kin Ya'a	Lake Valley, Los Aguages, Kimbeto Point, Tse Lichii LA 34324 LA 34310 LA 35415 (Herradura)

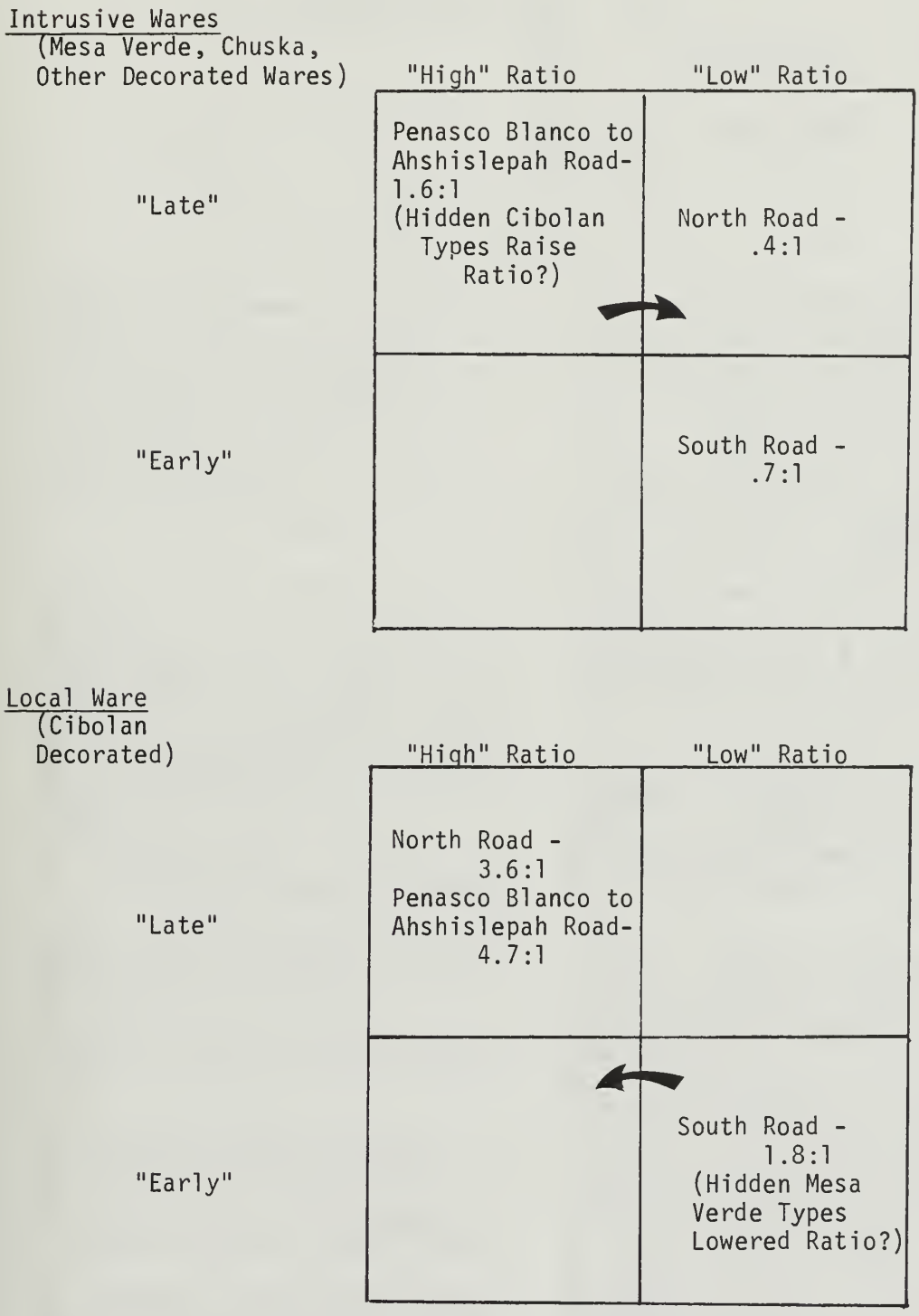
For local wares, the high jar:bowl ratios are consistent with earlier predictions for non-domiciliary assemblages. Unusually high proportions of jars on the Penasco Blanco to Ahshislepah Road may be explainable in part by the fact that this road provides access to extensive permanent water resources, and large numbers of jars may have been utilized to transport water. The highest local jar:bowl ratio of any functional group was recorded at Los Aguages, a Zambullida site located adjacent to several large bedrock cisterns.

The Penasco Blanco to Ahshislepah Road appears to have a slightly higher intrusive jar:bowl ratio than the other two roads, and the South Road appears to have a markedly lower local jar:bowl ratio than the other two roads. This difference could be explained at least in part by biases in ceramic classification, illustrated in Figure 9-23. As discussed earlier, there is probably a tendency for early decorated Mesa Verdean types to be classified as Cibolan due to difficulty in field identification. Since analysis showed that Mesa Verdean types tended to have lower ratios, the markedly lower local ratio for the South Road could be due in part to "hidden" (i.e., misclassified) Mesa Verde types which lower a normally high Cibolan ratio. The same factor could be operating in reverse for the intrusive jar:bowl ratio on the Penasco Blanco to Ahshislepah Road. Here late Cibolan types are probably "hidden" within the Mesa Verde category, a factor accentuated on this road because of the high percentage of Mesa Verde intrusives (see Figure 9-24). The hidden Cibolan types are probably responsible for the unusually high overall intrusive jar:bowl ratio noted for this road.

Another possible explanation of the lower local jar:bowl ratios on the South Road is the earlier date of many of the functional groups along this road, and the probability that many of the sites recorded were not actually "conditioned" by the presence of the road. If higher jar:bowl ratios are characteristic of road-associated non-domiciliary assemblages, then it is not surprising that sites recorded within the South Road corridor which are thought to pre-date the road do not exhibit these high ratios. Interestingly, the two functional categories on the South Road which do have unusually high jar:bowl ratios are Ceramic and Ceramic/Lithic scatters in Direct Association with the road alignment.

Analysis of other functional groups did not suggest that jar:bowl ratios were consistent within any one functional group across road corridors. For the road systems analyzed, variability appeared to be patterning mainly within the road corridors themselves. The reasons for this are not understood, but may be the result of different road functions, distribution of major sites, availability of different resources, etc.

Figure 9-23. Intrusive Versus Local Jar:Bowl Ratios by Road



	Local	Intrusive			
	Cibola (All)	Mesa Verde	Chuska (All)	White Mountain Red Ware	Other
North Road	80%	9%	5%	5%	1%
Penasco Blanco to Ahshislepah Road	73%	22%	3%	1%	1%
South Road	93%	1%	4%	1%	1%

Figure 9-24. Percentage Local and Intrusive Wares by Road.

Percent Utility Ware. The percentages of Cibola and Chuska utility ware in sites are listed in Table 9-7 and are also portrayed graphically in Figure 9-20. On all roads, Cibola wares accounted for the majority of the utility wares present; Chuska utility was present only in small quantities (usually less than 5 percent). The North Road and the Penasco Blanco to Ahshislepah Road generally showed lower percentages of utility ware than the South Road. Values for the North Road are undoubtedly inflated by high percentages of utility wares on major structural sites (see Table 9-10) (69 percent to 73 percent). The remaining site categories are generally much lower, although still higher than on the Penasco Blanco to Ahshislepah Road. Site categories along the South Road had uniformly high percentages of utility ware (60 percent or more) with the exception of the single Herradura, with a figure of only 27 percent.

The North Road and Penasco Blanco to Ahshislepah Road exhibit the low values predicted for non-domiciliary assemblages. Unusually high percentages of utility wares recorded on the South Road are probably a reflection of either the earlier dates or the domiciliary nature of the sites along this corridor which are thought to pre-date road construction.

Percent Intrusive Ware. Percentage figures for intrusive wares are presented in Table 9-8, and for ease of reference are repeated graphically in Figure 9-21. Overall, the North Road and Penasco Blanco to Ahshislepah Road show substantially higher percentages than the South Road. For the northern roads, the most frequent intrusive ware is Mesa Verde ware, which shows up in unusually large amounts on the Penasco Blanco to Ahshislepah Road (22 percent overall), particularly on artifactual scatters in Direct Association with the road alignment. This is consistent with the results of earlier analysis performed by Windes of material collected by Vivian. [During his 1971 survey of the roads (see Appendix A) Vivian collected a large ceramic sample from the cliff face above the Escavada Wash, across from Penasco Blanco.] This sample also yielded a very high percentage of Mesa Verde White wares. The generally low overall percentage of Mesa Verde wares on the North Road (less than 10 percent) is consistent with Morenon's interpretation of "south to north" directionality of trade between Chaco and the northern areas. On the South Road, it is interesting that the site category with the highest percentage of intrusive wares is the Herradura, which has 27 percent overall intrusives and 23 percent Mesa Verde wares. The remainder of the categories in the vicinity of the alignment have relatively low intrusive percentages (4 to 11 percent).

Other intrusive types, including Chuskan and red ware types, were present in the following amounts. On the North Road, 4.8 percent was White Mountain Red ware, .1 percent was undifferentiated red ware, .2 percent Socorro Black-on White, .8 percent Kayenta white ware, .1 percent Gogollon brown ware, and .1 percent Nava Black-on-White. On the Penasco Blanco to Ahshislepah Road, 1 percent was White Mountain Red ware, .3 percent was Tsegi Orange ware, .3 percent undifferentiated red ware, and .3 percent Navajo utility ware. On the South Road, .7 percent was White Mountain Red ware, .1 percent was San Juan Red ware, .6 percent was Puerco Black-on-Red, .2 percent was Wingate Black-on-Red, and .3 percent was Kayenta White ware.

Chuskan intrusives generally appeared in low numbers (5 percent or less overall) with a slightly lower representation on the Penasco Blanco to Ahshislepah Road. This appears to support interpretations by Powers, Gillespie and Lekson (1983) and Toll (1981) that Chuskan wares were not traded out of Chaco Canyon.

In general, the prediction of higher ratios of intrusive wares for non-domiciliary assemblages was supported by the results of the North Road and Penasco Blanco to Ahshislepah Road analyses. Again, the South Road showed divergent lower values, due either to temporal or fuctional factors.

Cibola White Ware. The distribution of types by road for Cibola White wares is summarized in Table 9-12. On roads in the immediate Chaco Canyon area (Windes 1981:19) and at Pueblo Alto (Toll 1981) higher

TABLE 9-12

PERCENTAGE OF CIBOLA WHITE WARES BY ROAD CORRIDOR

Type	North Road	Penasco Blanco to Ahshislepah Road	South Road
2.01 Undiagnostic, Undifferentiated Temper Size	16.8%	26.6%	1.8%
2.02 Undiagnostic, Coarse Temper	-	-	0.9%
2.03 Undiagnostic, Fine Temper	.4%	-	9.4%
2.04 La Plata, White Mound	-	-	2.1%
2.05 Red Mesa Black-on-White	.6%	1.3%	7.4%
2.06 Escavada Black-on-White	7.6%	2.0%	2.8%
2.07 Gallup Black-on-White	7.0%	10.8%	4.9%
2.08 Chaco Black-on-White	3.0%	2.3%	0.4%
2.09 Lino Black-on-White	-	-	0.3%
7.06 Chaco-McElmo	-	-	0.2%
	35.4%	43%	30.2%

percentages of Gallup B/W than Escavada B/W have been noted for sites along prehistoric road alignments. While this also appears to be the case for the Penasco Blanco to Ahshislepah Road (10.8 percent versus 2.0 percent), and the South Road (4.9 percent versus 2.8 percent), it is not the case for the North Road, where the two types are approximately equal (7.0 percent versus 7.6 percent).

Lithic Information. As a general rule, lithic assemblages recorded during the survey were quite small, with few formal tools or diagnostic artifacts present. Information is summarized here by functional category; in addition it is summarized for material culture scatters in Table 9-9.

Zambullida. Los Aguages (the only representative of this group for which lithic information was available) had two flakes, no ground stone, and no fire-cracked rock.

Herradura. No lithics, ground stone or fire-cracked rock were recorded for the single Herradura on the South Road.

Great Houses. In general, flaked stone assemblages were small, with only occasional ground stone or flaked stone tools recorded.

Roomblocks. Flaked stone was reported on 4 of the 7 roomblocks on the South Road; however, no site had more than 15 flakes present. No ground stone or fire-cracked rock were evident.

Avanzadas. Five of the eight Avanzadas on the North Road had lithics present. Two had probable fire-cracked rock, and two had ground stone. Only two pieces of flaked stone were recorded for the entire group, and three had hammerstones present.

Material Culture Scatters. The great majority of lithic artifacts were recorded on material culture scatters. A tabulation of this lithic information is presented in Table 9-9. Lithic material was by far most abundant on the North Road (present on 38 sites as opposed to 3 each for the other 2 roads). On the North Road, no Lithic sites were found in Direct Association with the road. All but one of the 11 Lithic/Ceramic and Ceramic/Lithic scatters had under 20 flakes, and none had ground stone or fire-cracked rock; all dated to the late eleventh century.

The single exception (LA 34279) is a Lithic/Ceramic site Directly Associated with the road. This site is interesting because it is the only site recorded exhibiting evidence of lithic procurement or processing activity which is Directly Associated with a road. It is primarily a lithic reduction area, with 21 associated ceramics recorded. The ceramic assemblage dates to the late eleventh century, contemporaneous with the rest of the road; however, it is anomalous in that there is a high proportion of utility ware (74 percent) in the assemblage, a figure inconsistent with the non-domiciliary pattern observed on the majority of sites on the North Road corridor.

Of the 12 Lithic sites in Proximity, at least two show evidence of Archaic occupation. Five have fire-cracked rock, four have ground stone; with a few exceptions assemblages are generally small and lack formal tools. Lithic assemblages associated with Ceramic/Lithic sites are all small (no more than 10 flakes) with no fire-cracked rock or ground stone present.

On the Penasco Blanco to Ahshislepah Road, the single Ceramic/Lithic Direct scatter associated with the ramp contained fire-cracked rock but only a scattering of flakes and no tools. The two other Lithic Proximity sites were quite small, containing only a few flakes each, although one contained a biface and a knife fragment.

On the South Road, lithics were recorded only in the context of large Ceramic/Lithic scatters in Direct and Proximate association with the road. In the case of the latter, lithic assemblages were fairly substantial, and a variety of tools was present.

The dominant material types were chalcedony and petrified wood or palmwood, both considered local materials. Only a few flakes of Brushy Basin chert were found, all on the North Road. Small amounts of Washington Pass chert were found on Kin Indian Ruin, on a single Ceramic/Lithic site on the North Road, on Upper Kin Klizhin, and on all of the material culture scatters with lithics on the South Road. Chinle chert was found in very small quantities on the North and Penasco Blanco to Ahshislepah Roads; a more substantial percentage was found on the South Road.

Lithic information reinforces our interpretation of the cultural environment of the North Road. The near absence of Lithic or Lithic/Ceramic sites, or any type of site with ground stone or fire-cracked rock in Direct Association with the alignment argues against extensive camping or processing which may have been done in connection with the use or construction of the road itself. The most extensive evidence of camping or processing was found on Lithic or Lithic/Ceramic sites in Proximity. The Ceramic/Lithic sites in Direct Association with, and in Proximity to, the alignment are all very similar: they have very few flakes or formal tools, no fire-cracked rock or ground stone and they consistently date to the late eleventh century. Extremely short-term or temporary occupation is indicated by these results.

A similar paucity of lithic materials was noted for the Penasco Blanco to Ahshislepah Road; on the South Road lithic material was found only in association with major material culture scatters in Proximity to the road alignment.

Of the intrusive materials, Washington Pass chert occurred more frequently on the South Road than on the other two roads, and Chinle chert seemed to occur mainly on Bonito Phase structures. However, these conclusions must be tempered by the fact that sample sizes were extremely small and extensive lithic documentation of these sites was not performed.

Material Culture Analysis Summary

The interpretation of the overall results of the material culture analysis remains clouded. It cannot be clearly stated that a road-associated functional pattern has been identified (even for the North and the Penasco Blanco to Ahshislepah Roads) because of the homogeneity of material culture traits for all sites within these road corridors. The only functional contrast suggested in the analysis appeared between these sites and sites in the South Road corridor, which appeared to belong to an early agricultural community. Because of the substantial chronological differences between these sites and the sites in the two other road corridors, it is not clear whether the seeming "functional" differences were in actuality the result of the earlier dates.

Analysis results substantiate the contemporaneity of sites within the North and Penasco Blanco to Ahshislepah Road corridors as indicated in Figure 9-4A. The fact that these sites also appear to be for the most part functionally homogeneous does not, however, establish that this functional pattern is, in fact, uniquely related to road construction or use. This would require establishing a functional contrast between contemporaneous sites within the same road corridor, not between non-contemporaneous sites on different road corridors, as has been done in present analysis. It is conceivable that this might require an expansion of the survey corridor boundaries (as shown in Figure 9-4B), if circumstances were such that the actual "zone of influence" of the road were greater than the 1/8 mile utilized for this study. This, however, is not suggested by the analysis of site densities in relationship to distance from the road alignment discussed earlier.

The inability to define functionally road-associated material culture traits is further reflected in the lack of homogeneity within categories of sites predicted to be functionally road-associated on the basis of spatial association and physical characteristics. This is illustrated in Figures 9-25, 9-26, and 9-27 by the lack of consistent trends in jar:bowl ratios, presence of utility ware, and presence of intrusives in site types predicted to be road-associated.

Considerable variability was observed in the material culture of Bonito Style great houses; while some appeared to have a typical domiciliary assemblage (low jar:bowl ratios, high percentage of utility ware, low percentage of intrusives) others exhibited the opposite trend (see Table 9-10 and Figures 9-28 and 9-29). Similarly, a wide range of dates for these sites was observed, some of them having been constructed in the

Figure 9-25 LOCAL JAR BOWL RATIOS BY ROAD AND FUNCTIONAL GROUPS, ARRANGED IN ORDER FROM HIGHEST TO LOWEST VALUES

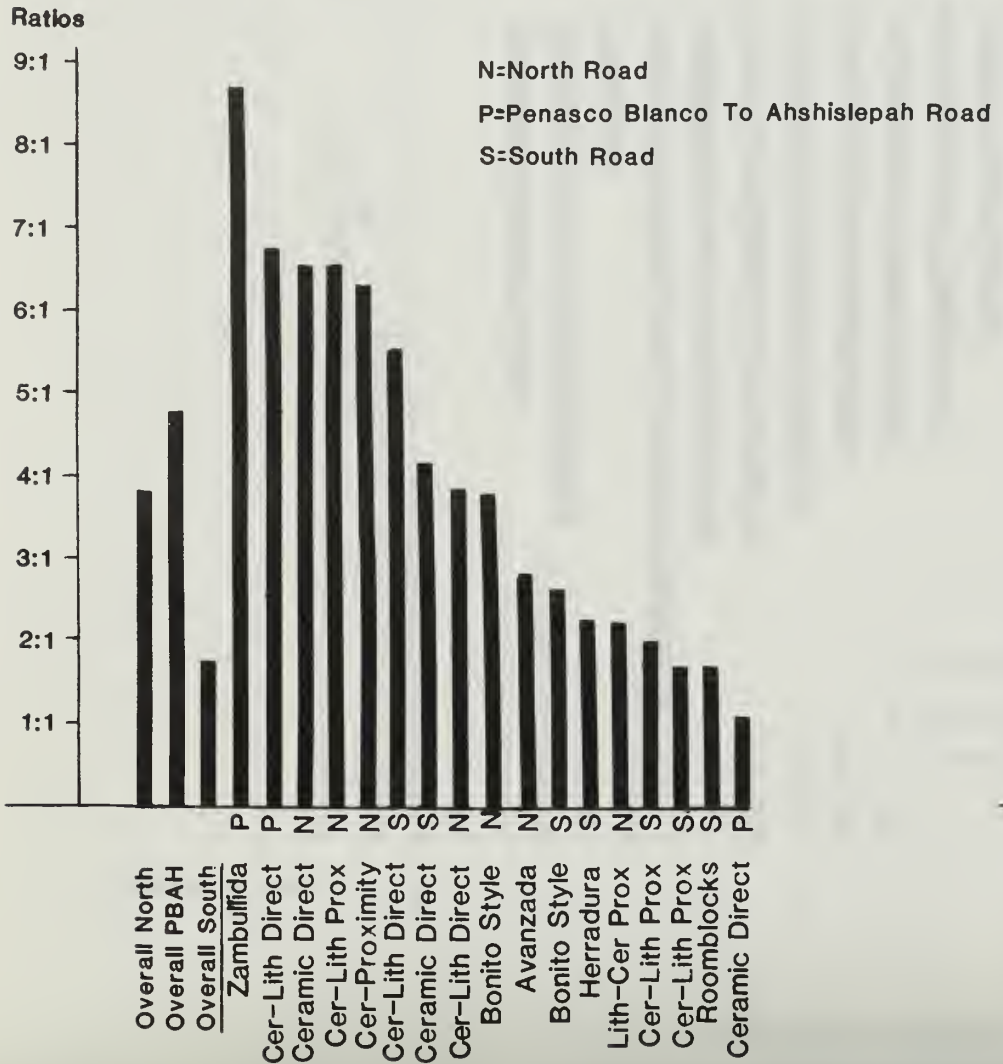


Figure 9 -26 PERCENTAGE UTILITY WARE BY ROAD AND GROUPS, ARRANGED IN ORDER FROM HIGHEST TO LOWEST VALUES

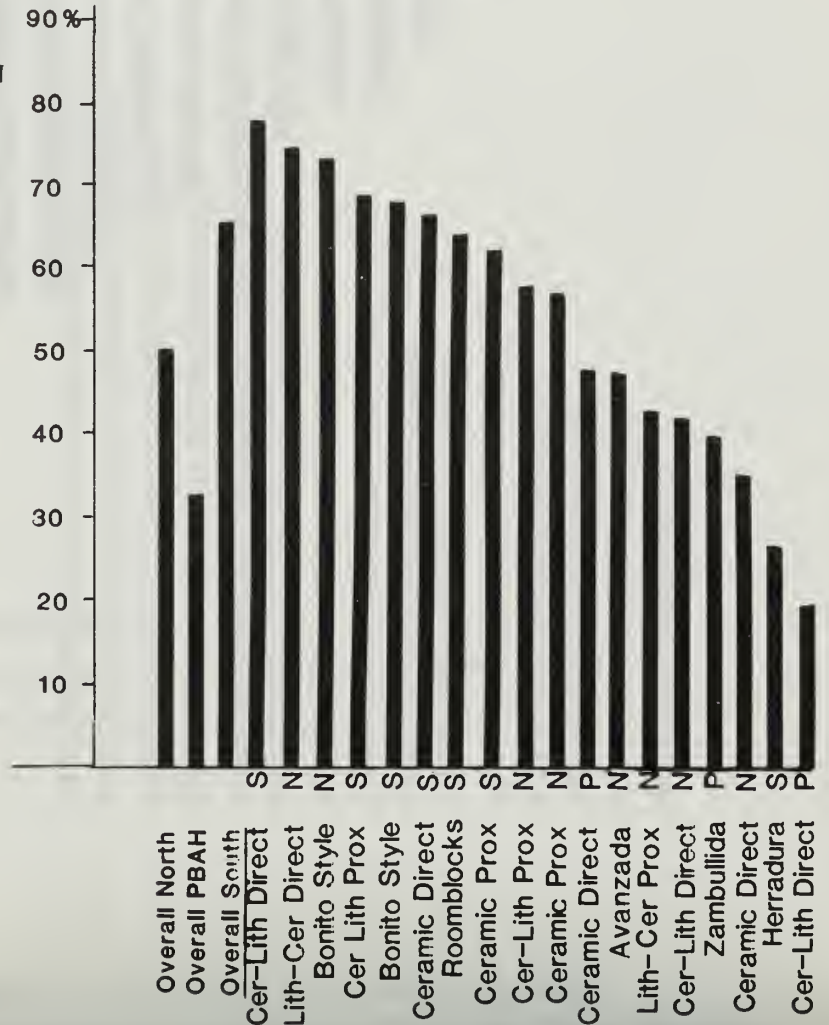


Figure 9-27 PERCENTAGE INTRUSIVE WARE BY ROAD AND FUNCTIONAL GROUPS, ARRANGED IN ORDER FROM HIGHEST TO LOWEST VALUES

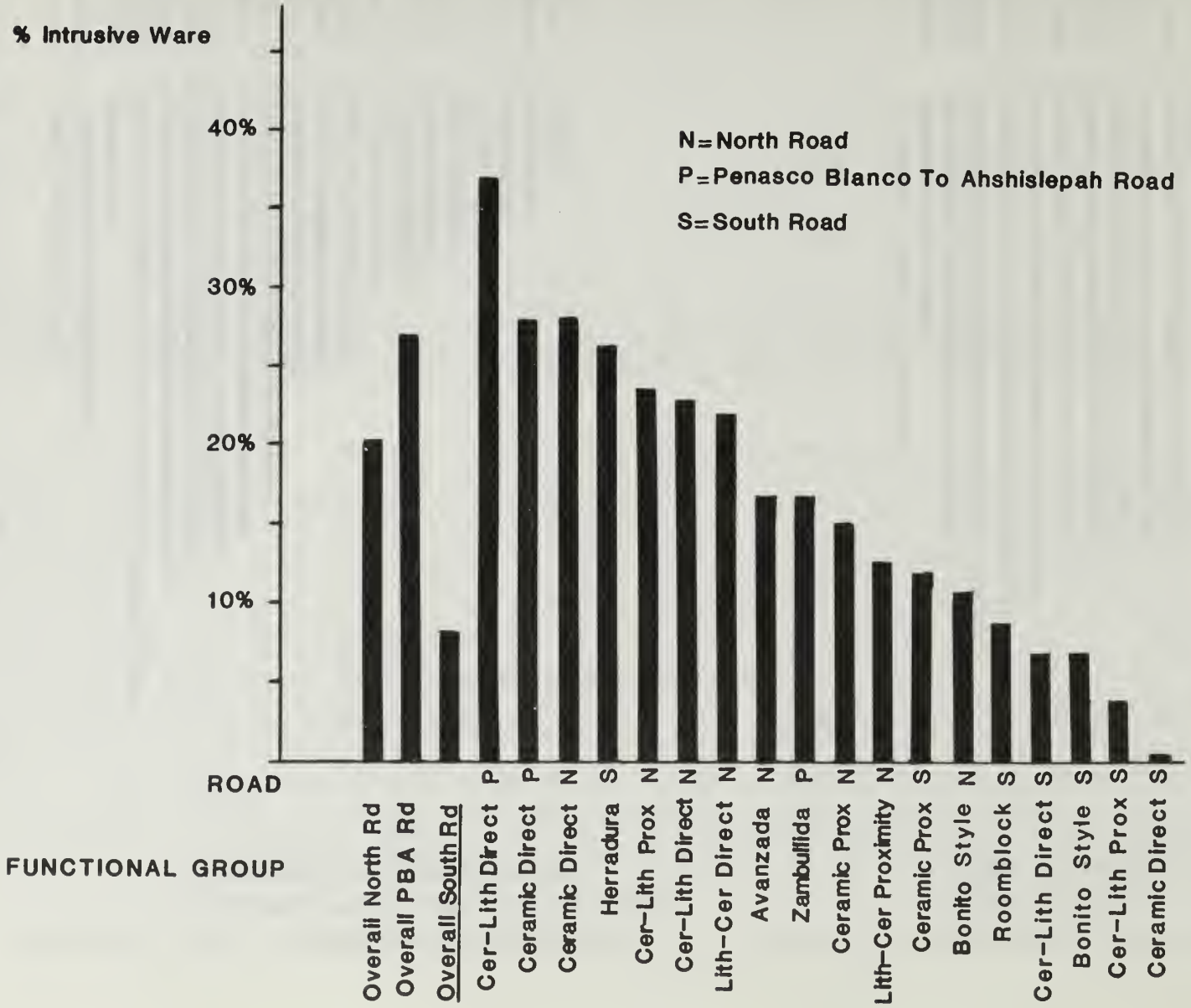


Figure 9-28 **PERCENT** INTRUSIVE WARES FOR MAJOR STRUCTURAL SITES

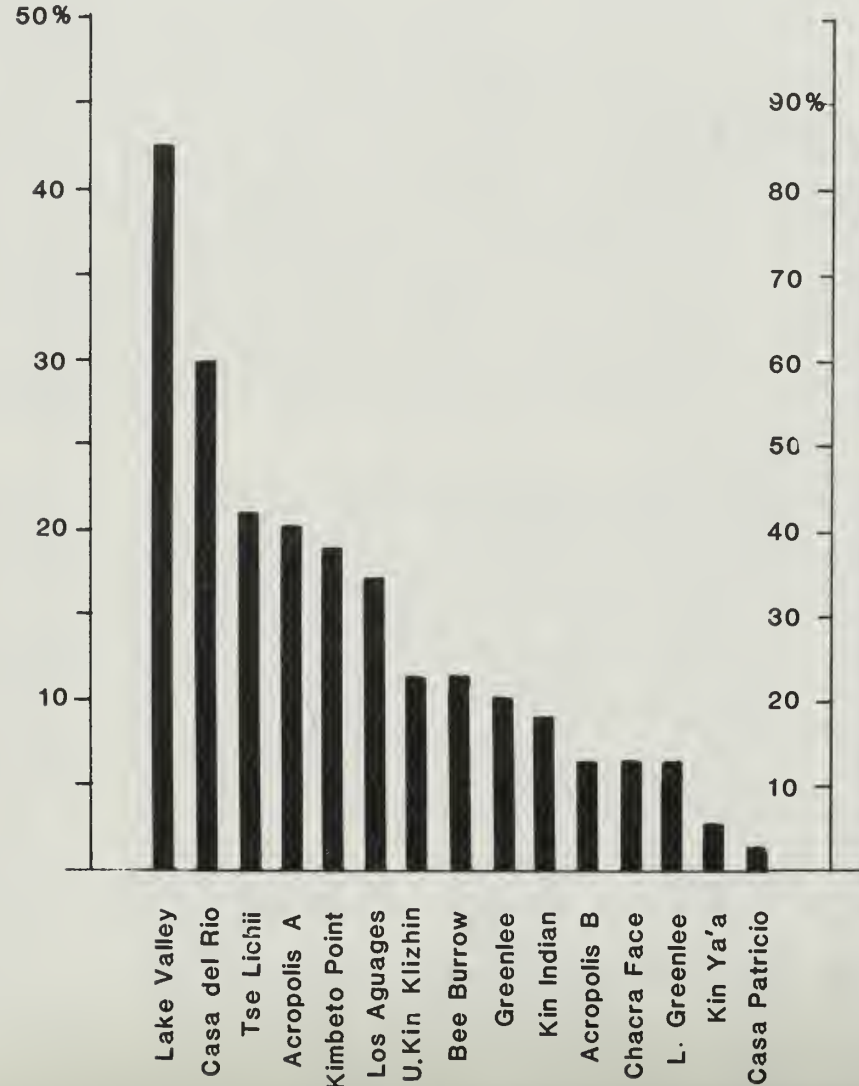
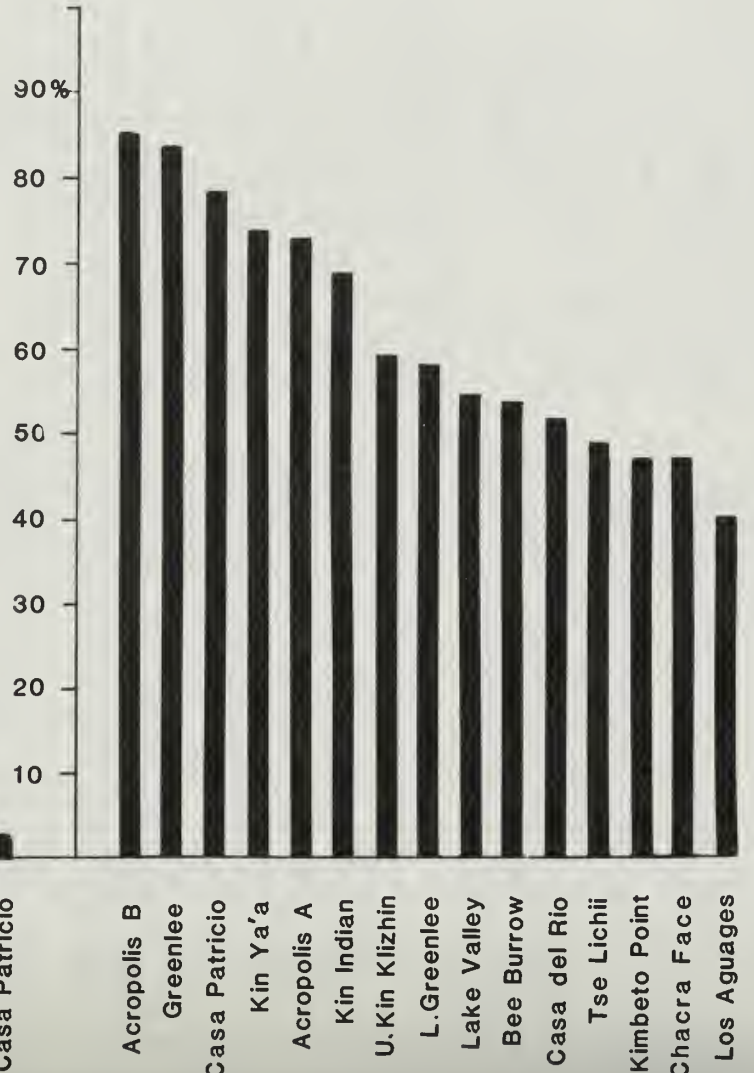


Figure 9-29 PERCENT UTILITYWARE FOR MAJOR STRUCTURAL SITES



900s and early 1000s, with others seemingly contemporaneous with the later period of road construction. Where information was available, traits observed for great houses seemed in many cases to mirror the attributes observed for material culture scatters and other lesser types of sites found along the road alignment; in other cases, however, sites and great houses seemed to substantially predate what was presumed to be the period of major road construction. This would seem to suggest that at least in some cases, road and great house construction served to formalize, in a very short time, a set of pre-existing interactive patterns. Clearly more work needs to be done to address this problem. The most important results of the current research effort probably lie in the demonstration of the interdependence of great houses, roads, and lesser sites along the roads in the interpretation and study of the Chacoan system. The role of any one great house or outlier community cannot be fully understood without complementary information concerning its role in the development and functioning of the road system(s) of which it is a part.

Similarly, interpretive studies directed towards a real understanding of the development and function of roads in Chacoan society must take into account not only the characteristics of the road alignment and lesser sites and material culture scatters along the way, but also the attributes of great houses or communities which functioned as nodes in the system.

Little information has been generated by the current study concerning the actual means of construction and context of use of the roads. For the most part, sites found along the road alignment appeared to be the product of only extremely casual use, not indicative of any particularly unique or sustained activity or habitation. The one notable exception to this was the group of large elongate Ceramic/Lithic scatters found within the North Road alignment south of Pierre's Ruin. With very few lithics present, and no evidence of sustained camping or subsistence activity (in the form of hearths, ground stone, etc.), the activities which took place on these sites remain a mystery. Yet their exclusive and Direct Association with the road alignment strongly suggest that they were somehow integral to road construction or use.

Road Verification Summary

In the following section the road verification strategy presented in this report is applied to each of the road corridors intensively inventoried. Ultimately, this strategy calls for the evaluation of several types of data accumulated using a variety of data recovery procedures, with a recommendation concerning the validity or lack of validity of the road as a prehistoric feature being the end product. In the following pages, information collected from the North, Penasco Blanco to Ahshislepah and South Road corridors is reviewed, resulting in the conclusion that these features, at least in the areas examined, are indeed prehistoric roads. Evidence presented in this discussion is summarized in Figure 9-30.

North Road

A substantial amount of information was collected supporting the verification of the North Road, which will be briefly summarized here. Low sun angle aerial photography taken during October 1981 resulted in an excellent photographic record of the North Road from Pueblo Alto to Kutz Canyon at scales of 1:12,000 and 1:24,000. In addition to providing base documentation of the road alignment, this photography revealed what appeared to be double parallels, or two sets of two roads extending for a distance of a few miles north of Pierre's Ruin.

Several subsurface trenches were placed along the North Road to test for evidence of construction and to isolate, if possible, differences between prehistoric and historic road profiles. Of six trenches placed across sections of prehistoric road, several showed evidence either of construction, or of interruptions in soil formation processes known to predate the historic period. The discovery of platy structure formation beneath the ruts of historic roads (visible in three trenches) established an objective, easily measurable criterion for testing for the presence of historic use on a road alignment. No surface rock counts were performed along this road.

Site densities along the North Road alignment provided additional evidence to support its verification as a prehistoric feature (see Table 9-1 and Figures 9-2 and 9-3). Twenty-two of the thirty-five prehistoric components excluding lithic scatters were found in Direct Association with the road; thirty-three were found within 100 meters of the centerline. Of the 12 lithic scatters in the corridor, none were found in Direct Association, and 8 were found within 100 meters. Only four historic components pre-dating the 1930s were found in the corridor, none in Direct Association. These findings were corroborated by evidence from Isolated Occurrences.

A number of sites were recorded which were thought to be road-associated by virtue of their spatial relationship to the road alignment. Perhaps the most intriguing category was that of the dense elongate Ceramic/ Lithic scatters, some over 100 m in length, which were recorded along the road alignment in an area of intermittent sand dunes just south of Pierre's Ruin. These sites lacked evidence of long-term use, such as hearths, ground stone, or any type of formalized lithic tools. Their function remains unknown.

Another problematic site category was that of masonry structures, called here Avanzadas to

Location	Subsurface Evidence of Construction	Surface Rock Counts	Higher Densities of Prehistoric Material Along Alignment	Presence of Sites Road-Associated by Virtue of Spatial Arrangement	Presence of Sites With Unique Physical Characteristics	Presence of Road-Associated Traits in Material Culture
North Road	North Road Trenches - 1, 2, 3, 4, 8, 9, 10, 13 Historic Road Trenches - 8, 9 and 13 Evidence of construction found in Trenches - 1 and 10	No rock counts compeleted.	Higher densities of prehistoric sites (excluding lithic scatters) correlate with the alignment. Pre-1930 historic sites do not show increased densities.	1-Zambullida 4-Bonito Phase 14-Material culture scatters in Direct Association 8-Masonry structures 16-Visible swales	1-Zambullida 4-Bonito Phase	All datable sites post-date 1050 A. D. High local jar:bowl ratio (3.8:1) Relatively low percentage of utility ware (50%) Relatively high percentage of intrusives (20%)
Penasco Blanco to Ahshislepah Road	Trenches 11 and 12 11 showed positive evidence of construction. 12 showed probable evidence.	Rock counts at Trench 12 showed evidence of construction.	Higher densities of prehistoric sites (excluding lithic scatters) correlate with the alignment. Pre-1930 historic sites do not show increased densities.	1-Zambullida 5-Material culture scatters in Direct Association 11-Visible swales 1-Ramp 1-Staircase 1-Hand-and-toe hold	1-Zambullida	All datable sites post-date 1050 A. D. High local jar:bowl ratio (4.7:1) Relatively low percentage of utility ware (31%) Relatively high percentage of intrusives (27%)
South Road	No Trenches - however, surface observations conclusively indicate construction in some locations.	No rock counts completed.	Higher densities of prehistoric sites (excluding lithic scatters) correlate with the alignment. Pre-1930 historic sites do not show increased densities.	1-Herradura 4-Bonito Phase 3-Material culture scatters in Direct Association 9-Visible Swales	1-Herradura 4-Bonito Phase	Most sites date to 800's or 900's Local jar:bowl ratio is relatively low (1.8:1) Relatively high percentage of utility ware (65%) Relatively low percentage of intrusives (7%)

Figure 9-30. Summary of Evidence for Verification of Surveyed Road Alignments

distinguish them from other simple masonry rooms not thought to be road-associated. Avanzadas are simple masonry structures generally found in a Consistent Topographic Position above the road alignment. Material culture is usually sparse and the function of these sites is unknown, although they are presumed to be road-related.

Sixteen visible swales were recorded along the North Road alignment from the Escavada Wash to Pierre's Ruin. While ground visibility was highly variable, the road was most distinct in the sand dune area south of Pierre's Ruin.

Sites within the corridor considered to have road-associated structural characteristics included four great houses (Kin Indian Ruin, Pierre's Acropolis A and B, and El Faro) and a Zambullida (Acropolis C).

In most respects, North Road assemblages conformed to the pattern predicted for non-domiciliary road-associated sites. Analysis of material culture showed that with few exceptions, datable sites along the North Road corridor showed dates of post-1050 AD. High jar:bowl ratios (for local wares), low percentage of utility wares, and high percentage of intrusive wares were recorded as predicted. Mesa Verde wares were the dominant intrusive group, with Chuskan wares present in lesser amounts.

Survey evidence suggests that the cultural environment of this road at the time of construction did not consist of more than ephemeral use. Signs of a late Archaic occupation of portions of the survey corridor were found; however, few Anasazi remains which could be considered to pre-date the road were recorded. Substantial chronological homogeneity in the material culture assemblages suggests that the North Road can be viewed as a single construction event occurring in the late Bonito Phase. The small size of sites contemporaneous with the road, coupled with their lack of features and evidence of sustained or repeated use, suggests that the road failed to induce or facilitate permanent habitation settlement.

As with other roads, important information concerning the construction and use of the North Road is thought to lie within the great house structures associated with it. Kin Indian and Pierre's Ruin appear to have been constructed contemporaneously with each other and with the road. The nature of road-site association at both of these ruins is poorly understood, and the many unique aspects of Pierre's Ruin suggest that it was highly significant in the construction and use of the road.

Penasco Blanco to Ahshislepah Road

Information recorded in the field supported the verification of the Penasco Blanco to Ahshislepah Road as a prehistoric feature. Two subsurface trenches were placed across the alignment, Trench 11 and Trench 12; at both locations, evidence of construction was found in the form of disturbance of natural soil formation processes and interruption of subsurface stratification within the road alignment. Surface rock counts performed at rock count Transect 3 (near Trench 12) revealed the presence of subsurface lithologies above ground, corroborating the interpretation of deliberate construction or maintenance as opposed to simple erosion of the road surface as the primary cause of road visibility.

Additional evidence supporting verification was provided by site density histograms, although low site counts reduce the reliability of this information. Six of the eight prehistoric components excluding lithic scatters were found in Direct Association with the alignment, in contrast to no lithic or historic components. The same trend was noted for Isolated Occurrrences (refer to Table 9-1, Figures 9-2 and 9-3).

Of the several sites and features found in Direct Association with this alignment, perhaps most unique is the site called Los Aguages (classified in this report as a Zambullida), consisting of three structures having Bonito Style architecture which occupy a strategic position at the intersection of the road and a series of bedrock cisterns. Several features, including a ramp, stairs and hand-and-toe holds were also located along the alignment; in addition five material culture scatters were found in Direct Association. Subsurface conditions for the preservation of visibility were excellent; a thin soil mantle overlying rocky substrate was noted along almost the entire alignment, and visible swales were recorded in 11 dispersed locations.

Analysis of material culture revealed a pattern quite similar to that of the North Road, which was predicted for non-domiciliary road-associated assemblages. Again, sites along the road were chronologically homogeneous, dating to the late 1000s. Average jar:bowl ratios for local wares were even higher than those along the North Road; percentage of utility ware was lower, and percentage of intrusive wares higher. The Penasco Blanco to Ahshislepah Road showed a substantially higher percentage than any of the other roads (22 percent overall) of carbon-painted white wares.

Survey evidence suggests that the area was virtually unoccupied by Anasazi groups prior to the construction of the road, although Archaic and Navajo remains indicate substantially earlier and later occupations. Ceramic Frequency Graphs do suggest a slightly earlier beginning date for Los Aguages; however in general sites along this road conform to the "late" pattern of the North Road.

The fact that this road leads directly to an excellent water source suggests that the location of the water may have in some way influenced the course of the road. This is

somewhat problematic in that the road actually continues beyond Los Aguages, and has been traced as far as Ahshislepah Wash. (Editor's Note: See Chapter 11.) However the unusually high jar:bowl ratio on this road does appear consistent with the transporting of water from the cisterns, which would presumably have been done in jars.

South Road

Again, information collected during field studies indicated the verification of the South Road as a prehistoric road alignment. Trenching and rock count studies were not conducted on this road.

Site density figures reveal that a lower percentage of prehistoric non-lithic components were found in Direct Association with the alignment (39 percent as opposed to 63 percent and 75 percent for the North and Penasco Blanco to Ahshislepah Roads). However, 83 percent (16 of the 18 components) were found within 100 m of the alignment.

Sites located in Direct Association included a single Herradura, as well as nine visible swales and three material culture scatters. In addition, four large structural sites in Direct Association with the alignment were studied, two within the survey corridor (Upper Kin Klizhin and Casa Patricio) and two south of it (Bee Burrow and Kin Ya'a).

The South Road is in many respects inconsistent with the two roads discussed previously. Because it passes through an early agricultural community, mean site dates range in the ninth and tenth centuries. Material culture analysis revealed higher percentages of utility ware, lower percentages of intrusive wares, and generally lower jar:bowl ratios for Cibolan ceramics than were found on the other two corridors. Great house and great kiva structures appeared to have been occupied sequentially. Casa Patricio showed evidence of only early occupation, Upper Kin Klizhin was occupied during early, middle and late periods, and Bee Burrow and Kin Ya'a showed exclusively late occupations.

We would reconstruct the events of the South Road as follows. At or around 800-850 AD, the great kiva Casa Patricio served as a community center for a community that was dispersed along the Kin Klizhin Wash. (This situation is similar to the one at Kin Bineola, where an early community was dispersed along the Kimmenioli Wash in the vicinity of the great kiva LA 18707.) Construction of Upper Kin Klizhin, on the opposite side of the Kin Klizhin Valley, probably took place at sometime between 900 and 950 AD. This is contemporaneous with the appearance of Bonito Style architecture elsewhere on the Basin floor. The construction of Upper Kin Klizhin itself appears to be partially contemporaneous with the occupation of Casa Patricio. The tower kiva structure may have been placed on a previously occupied site, which would account for some of the earlier dates for this location. Upper Kin Klizhin therefore is an early Bonito Style manifestation that may have originally complemented the great kiva at Casa Patricio but ultimately replaced that kiva as the focus of a community. Ceramic samples for Upper Kin Klizhin indicate early, middle and late periods of use, a trend reflected sporadically in both structural and non-structural remains elsewhere within the survey corridor.

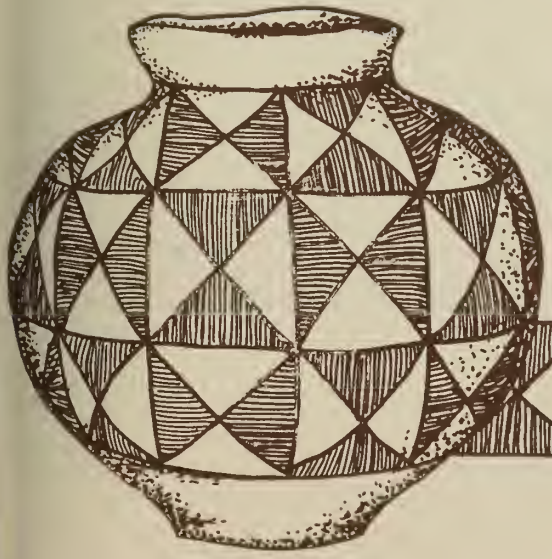
Examination of aerial photographs of the Upper Kin Klizhin Valley reveals that the South Road is clearly articulated with both Casa Patricio and Upper Kin Klizhin. In the case of Upper Kin Klizhin, this articulation is facilitated by a spur departing from the main alignment and rejoining it at a point beyond the ruin; at Casa Patricio, the great kiva is simply very close to the alignment (see Figure 8-8). It is interesting to note that road construction, involving formal articulation with Casa Patricio, probably took place nearly 200 years subsequent to the virtual abandonment of the structure as a ceremonial center. Low counts of late ceramic types may be the result of road use, but they do not indicate substantial occupation of the structure. Similarly, temporal data indicate that the formalization of the road surface post-dated the primary occupation of the Upper Kin Klizhin community.

It appears therefore that even though the South Road directly articulated with both Casa Patricio and Upper Kin Klizhin, they probably do not qualify as "endpoints" or destinations in that they did not function as major population centers at the time of road construction and use. The question remains, why were they incorporated into the road system?

This location on the South Road is an excellent example of a formalized road surface impacting an abandoned or partially abandoned Anasazi community, and is an extremely important location for study of the formalization of the Chacoan road network.

Chapter Summary

In this chapter, site densities near the road alignment are evaluated, the problem of defining association between archaeological remains and the alignment is addressed, and information concerning the verification of each of the major road systems studied during the current project is summarized. One type of evidence suggesting a prehistoric origin for the alignment is a high number of ceramic sites within the alignment, and an increase in density of ceramic sites within close proximity to the alignment. For the most part, similar patterns were not observed for lithic and historic sites. Road-site association was defined as either spatial association (including the categories of Direct Association, Consistent Topographic Position, and Simple Physical Proximity), or functional association (as indicated by analysis of material culture attributes). A detailed description of types of architectural sites thought to be road-associated by virtue of spatial patterning with the alignment is presented here, as well as a discussion of those types of sites which are easily confused with them. Material culture analysis shows that in general, sites found along the road alignment which date to the period of road construction and use (1050-1125 AD) exhibited anticipated patterns of high local jar:bowl rations, low percentages of utility wares, and high percentages of intrusive wares. Lithic assemblages were limited, and no evidence of road-associated extended camping or construction was found along any of the alignments. The accumulated evidence collected from the road systems under intensive investigation indicates the verification of the prehistoric origin of these features.



CHAPTER 10

CHAPTER 10

ROADS MANAGEMENT PLAN

The purpose of a management plan is to provide a background of technical information upon which to base management decisions. Most management decisions concerning cultural resource protection fall within the realm of 1) determination of proper levels of and procedures for inventory, 2) assessment of significance, and 3) selection of procedures to be followed which will adequately protect the resource or the significant aspects of the resource from undue degradation due to natural or man-induced causes. In the following chapter, information presented previously is re-organized in a format which more explicitly addresses these management concerns. To the degree that it reiterates much of the information contained in the earlier chapters, it serves also as a summary of many of the most important results of this project.

Inventory Strategies

As indicated in Chapter 4, it is highly probable that presently unrecognized prehistoric road systems once existed in the San Juan Basin. At least some of these road systems may be recoverable using modern techniques of exploration and analysis, if procedures are followed which will maximize the chances of their recognition.

The inventory procedures recommended in this report depart from standard inventory approaches in a number of ways. First, a phased approach is described which begins with the careful evaluation of information contained in aerial photography. The results of the aerial photography evaluation weigh heavily on subsequent decisions concerning inventory location and methodology. Second, a cumulative approach to data collection has been developed where information pertaining to the photographed image of the road, its environmental and archaeological setting, and its physical characteristics are integrated to form a single body of data pertaining to the road segment or system. Third, a strategy is developed in which the verification of the prehistoric road is subject to consideration at several different points in the process, and where a decision on verification is seen as one of the major research objectives. A flow diagram depicting important stages in the roads inventory procedure is shown in Figure 10-1.

Two types of prehistoric road management situations may be visualized as potentially occurring on any project initiated in the San Juan Basin: 1) those situations where visible road segments or a projected road alignment have been identified in the project area; and 2) those situations where no visible segments or projected alignments have been identified, but where there is thought to be some potential for their existence. Each is discussed separately below.

Areas Having Visible Segments or Projected Alignments

Evaluation of Existing Data. Inventory begins with an evaluation of a number of different kinds of existing information. This step provides the researcher with a knowledge of the many variations in appearance of prehistoric roads on the ground, and acquaints him with the kinds of sites and features which could be considered indicative of the presence of a road alignment. In addition, it provides ideas as to possible structuring of field activities, and suggests data collection priorities for field documentation.

Environmental data is critical in interpreting variations in road visibility, in predicting areas where evidence of construction is likely to be preserved, and in establishing priority areas for field studies. The following kinds of environmental information may prove useful:

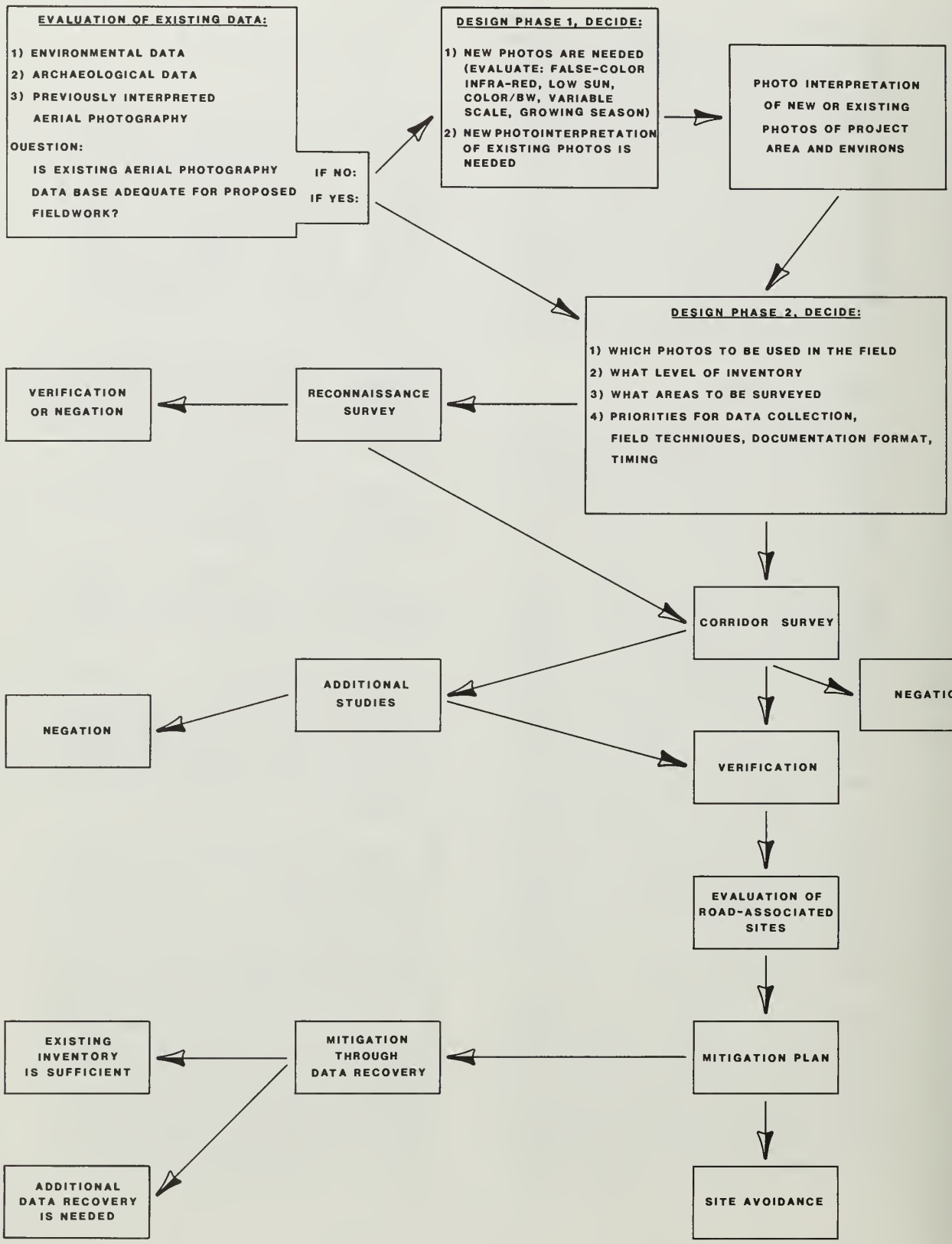
1. Vegetation information, including the identification of annuals and disturbance plants by plant community type or soil type (see Appendix B, Table B-1);

2. Topographic information, including identification of major topographic features and obstacles to travel, slope, road-slope relationships, and assessment of the visible horizon from the project area.

3. Soils and substrate information, including identification of areas of agricultural productivity, localized sequences of prehistoric and historic erosion and deposition, depth of the soil/sediment mantle, composition (texture) and origin of this material, type of bedrock beneath the soil/sediment mantle, and presence or absence of lag gravels.

The comparison and correlation of pertinent archaeological data is another important step in project preparation. This type of information is useful in interpreting the cultural environment of the road system, and can alert one to the presence of nearby road-associated types of sites or to unusually linear patterns of site distribution in the surrounding areas. Information concerning previous road studies in the area can be useful in predicting the ground visibility of the alignment, and in establishing priorities for both reconnaissance and corridor inventory efforts. (A discussion of previous road-related research is presented in Chapter 3 and in Appendix A.) The location of all sites within at least 1/2 mile of the imaged alignment should be recorded on field maps prior to survey, and

Figure 10 - 1
FLOW DIAGRAM SHOWING STAGES IN ROADS RESEARCH


EVALUATION OF EXISTING DATA:
1) ENVIRONMENTAL DATA
2) ARCHAEOLOGICAL DATA
3) PREVIOUSLY INTERPRETED AERIAL PHOTOGRAPHY
QUESTION:
IS EXISTING AERIAL PHOTOGRAPHY DATA BASE ADEQUATE FOR PROPOSED FIELDWORK?
IF NO:
IF YES:
DESIGN PHASE 1, DECIDE:
1) NEW PHOTOS ARE NEEDED (EVALUATE: FALSE-COLOR INFRA-RED, LOW SUN, COLOR/BW, VARIABLE SCALE, GROWING SEASON)
2) NEW PHOTOINTERPRETATION OF EXISTING PHOTOS IS NEEDED
PHOTO INTERPRETATION OF NEW OR EXISTING PHOTOS OF PROJECT AREA AND ENVIRONS
DESIGN PHASE 2, DECIDE:
1) WHICH PHOTOS TO BE USED IN THE FIELD
2) WHAT LEVEL OF INVENTORY
3) WHAT AREAS TO BE SURVEYED
4) PRIORITIES FOR DATA COLLECTION, FIELD TECHNIOUES, DOCUMENTATION FORMAT, TIMING
VERIFICATION OR NEGATION
RECONNAISSANCE SURVEY
CORRIDOR SURVEY
ADDITIONAL STUDIES
NEGATION
NEGATION
VERIFICATION
EVALUATION OF ROAD-ASSOCIATED SITES
EXISTING INVENTORY IS SUFFICIENT
MITIGATION THROUGH DATA RECOVERY
MITIGATION PLAN
ADDITIONAL DATA RECOVERY IS NEEDED
SITE AVOIDANCE

appropriate site records should be made available to the field crews.

Another important type of existing information to be evaluated is the amount and quality of aerial photography of the project area and vicinity and whether or not that photography has been subjected to photointerpretation for prehistoric roads. This step is essential, since with few exceptions, virtually all initial identification of prehistoric roads has been made on aerial photography, and the use of aerial photography during field inventory is an absolute necessity. Most areas in the Basin have been imaged on one or more aerial photography contracts, which should be evaluated on a project-by-project basis for their potential utility in roads research. Annotated sets of SCS 1930s photography and BLM 1973 and BLM 1981 photography are located in the BLM, Albuquerque District Office; an annotated set of USGS 1950s-1960s photography is located at the Branch of Remote Sensing, Division of Cultural Research, Southwest Cultural Resources Center, National Park Service, Albuquerque. In addition, a set of USGS 7.5' base maps showing the locations of imaged segments of all major road systems is located in the BLM Albuquerque District Office.

At this point, the adequacy of the existing aerial photography data base should be realistically evaluated. Two main factors should be considered. First, the quality of the photography (as affected by date, scale, processing, time of year, time of day, etc.) should be sufficient to allow for reasonably effective field application. As a general rule the better the photographs, the more efficient, effective and accurate the inventory; new photographs are relatively inexpensive when compared to wasted time in the field, inaccurate recording and inappropriate mitigation procedures. Specifications for new imagery are discussed in Chapter 4, and the benefits of new imagery are discussed in Chapters 4 and 5. In addition, the need for additional photointerpretation should be evaluated. If not all of the existing imagery for the project area has been photointerpreted, this should be considered, since the visibility of roads tends to vary widely between sets of photographs.

Design Phase I. If it is determined that the photographic data base is inadequate, the project enters Design Phase I, where plans are made for additional work (Figure 10-1). If additional photos are needed, decisions must be made concerning the type of photo needed (film, scale, time of year, time of day, etc.) and the project schedule should be adjusted accordingly. If additional photointerpretation of existing photos is necessary, time should be allowed for the acquisition of the photos and the completion of the photointerpretation work.

Photointerpretation. Photointerpretation should be completed following the techniques described by Obenauf in Chapter 4 and utilizing the photorecognition criteria presented by Nials in Chapter 5. The photointerpretation phase is critical, in that it provides the field archaeologist with a point of departure on the ground. It is essential that an experienced photointerpreter be utilized in this process, due to the difficulty of distinguishing on aerial photographs between prehistoric roads and features which are of a natural or historic cultural origin. A general idea of the complexity of this process can be gained by reading Chapter 5; however, the actual ability to consistently distinguish prehistoric roads on the photograph requires training in the field of photointerpretation and experience in recognizing prehistoric roads. After the initial photointerpretation phase has been performed and possible prehistoric alignments have been identified, most field archaeologists have the capability of utilizing photographs in the field to locate and guide inventory operations, given a properly scaled image.

Documentation of photointerpretation results must be compatible with field documentation and easily integrated with it. The use of a Photointerpretation Form (Figure 4-2) is suggested (see Chapter 4). The locations of all potential prehistoric alignments should be transferred to 7.5' USGS topographic quadrangle maps or other suitable maps of the project area. Accurate transfer of the location of the imaged alignment is extremely important to the success of the field work. The use of a Transferscope or Mapograph is virtually essential, since the lack of precision in the transfer process can easily result in excessive errors of up to 1/8 to 1/4 mile. Although aerial photography is normally useful for locating the imaged segments on the ground, it is actually the topographic map which is the "common denominator" of graphic management information. In most cases topographic maps will become management's working record of the nature and location of the road systems and features. For this reason, it is of primary importance to ensure that the photographed image of the road, as well as all associated features and sites including ground-visible swales, are accurately plotted on the best possible map base.

Design Phase II. At this point critical decisions concerning project implementation will be made. Photos to be used in the field must be selected and acquired. Where the project area is large, it may only be feasible to purchase a single set of photos, since it is usually desirable to purchase complete sets in order to maintain stereo pairs for viewing under the stereoscope. This selection should be made carefully, keeping in mind not only the visibility of the prehistoric roads but also the usability

of the photos on the ground.

Another important decision concerns the level of inventory to be performed and the locations of inventory areas. A phased approach may be most appropriate, where work is begun with a general reconnaissance survey which is followed by a more intensive corridor survey (see below). The development of the inventory strategy is probably the most important single aspect of the entire field phase. Planning must adequately cover the contingency of not finding the prehistoric alignment during reconnaissance, and allow time and resources for increasingly intensive levels of inventory to be completed (up to the intensive corridor survey) if a recommendation as to the verification of the road system is expected.

A number of questions concerning basic field methodology will also be settled at this time. These include the determination of priorities for data collection, the development of field techniques, and the selection of data recording formats. These methodologies have been discussed in Chapters 7, 8 and 9.

Reconnaissance Survey. In many instances, the first phase of field work will be the reconnaissance survey. The reconnaissance survey serves as a first step in the verification process. It allows evaluation of the visibility of the road from the ground perspective, the factors affecting road visibility in various environmental settings, and the nature and amount of cultural materials along the alignment. During this phase, the natural setting of the road should be considered, and an attempt made to determine those areas where the road might be most visible given propitious combinations of soil, topographic and substrate conditions. Vegetation cover should be noted, since under certain conditions vegetation can be an excellent indicator of the presence of the road alignment, while at other times it can virtually completely mask the alignment. Proper timing of the survey with respect to the growing season should be considered during the planning stages of field work.

The amount of cultural material adjacent to or within the alignment can also be assessed during reconnaissance survey. This is extremely important, since it can substantially affect the amount of time required to complete more intensive inventory. In areas of high site density more recording time will generally be required than for areas of low site density, unless the location of the alignment is difficult to establish. In this case, additional time for pin flagging, laying lathe on the centerline, backsighting along the alignment, and detailed recording should be allowed.

Several factors should be taken into consideration in the selection of areas to be examined in a reconnaissance survey. First, specific needs generated by management concerns should be assessed. In addition, the general visibility and amount of evidence for the road alignment should be evaluated. In cases where the road is extremely visible and the location of the alignment fairly certain (for example along selected portions of the North and South roads), reconnaissance survey outside the immediate project area may not be necessary. If, however, the actual road alignment has not been identified on the ground within the project area or the immediate vicinity (i.e., it has been projected along a bearing into the project area), a reconnaissance survey may be necessary to actually confirm the best location for beginning a corridor inventory, or to confirm the presence of some type of physical evidence supporting the existence of a prehistoric road in this location. It may be necessary to begin reconnaissance efforts at the location nearest the project area where the road or evidence of the road is actually visible on the ground or on the imagery, and attempt to follow the alignment into the project area. This will be effective only in situations where cultural remains or previously unrecognized swales give clear indications of the presence of the roadway. Where this does not occur, it may be necessary to utilize the more intensive corridor survey approach along the projected alignment as described below.

During the course of the survey, particular attention should be given to topographic positions where previously identified types of road-associated sites are most likely to occur (see Chapter 9), as well as to those landform-substrate types where roads are most likely to be preserved or visibility accentuated through erosional processes (see Chapter 5). Information to be recorded in the field should include both natural and cultural variability related both to road surfaces and to sites associated with the road surfaces (see Chapters 6, 7, 8 and 9). In addition, it should aid in determining the appropriateness of possible mitigation measures, including subsurface testing.

A list of data collection priorities for roads inventory work is presented in Table 10-1. It should be noted that these priorities vary from standard field techniques in the following ways: 1) a more detailed assessment of environmental variability is called for, emphasizing soils geologic and topographic variability; 2) specialized formats are needed for recording results of photointerpretation, the characteristics of the visible swale, and site characteristics; 3) special emphasis is placed on recording the location of the road alignment and its physical relationship to sites and features located along the alignment; and 4) special emphasis is placed on recording the configuration and topographic position of sites.

TABLE 10-1

DATA COLLECTION PRIORITIES FOR INVENTORY OF ROAD SYSTEMS

I. Evaluation of Existing Data

- A. Environmental data
  1. Vegetation
  2. Topography
  3. Soils and substrate
- B. Archaeological record
- C. Aerial photography

II. Imaged Segments

- A. Completed Photo Interpretation Form for each imaged segment
- B. Results of ground observations of imaged segments
- C. Locations of imaged segments on 7.5' topographic base map
- D. Description and results of new photography flown for project

III. Ground-Visible Segments

- A. Surface Observations
  1. Morphological characteristics of identified swales
  2. Assessment of favorable locations for sub-surface trenching
  3. Completed Visible Segment Form
  4. Presumed swale-site relationships
- B. Additional studies
  1. Subsurface trenching and profile description
  2. Stone counts
  3. Chemical soil analyses
  4. Mechanical soil analyses
  5. Vegetation monitoring

IV. Sites and features associated with the road

- A. Site map, showing:
  1. Boundaries and internal features of site
  2. Location of site with respect to road alignment
  3. Local topographic features
- B. Cultural and chronological affiliation, functional types, morphological characteristics
- C. Material culture
  1. Ceramic assemblage composition, jar:bowl ratios, etc.
  2. Flakes stone assemblage (material type, morphology, use, manufacture)
  3. Other artifactual types
- D. Spatial distribution of all types of sites with respect to road alignment

In many instances, the reconnaissance survey can serve as an initial ground check of photolineations. Verification of the lineation as a prehistoric feature may be achieved by the reconnaissance survey, or may require more intensive survey or additional studies (see Figure 10-1). Future researchers should maintain the distinction between the verification of a road system and the verification of a road segment. The former implies that sufficient information has been collected to confirm not only that the lineation is a prehistoric feature, but also that the feature extends at least as far as identified end points. The latter implies that a particular visible segment has been confirmed as a prehistoric road, but does not imply that this feature is, in fact, part of an identified road system. The decision as to how many verified road segments are needed to verify a road system is a subjective one, based on factors such as the number, type and distribution of visible segments, the presence of evidence for construction, and the lack of evidence for an historic origin. Further discussion of this issue can be found in Chapter 4.

As a final note, it should be re-emphasized that collection of road-associated material culture scatters is generally inappropriate during initial road inventories. As one of the primary components of the road itself, associated artifactual materials often enhance the visibility of the roadway in situations where there may be no other visible manifestation of it. Collection inevitably leads to the loss or reduction of visibility for all or a portion of the road alignment, reducing or eliminating the chance of recovering additional information.

Corridor Survey. The major difference between the corridor and reconnaissance inventories lies in the intensity of coverage of the survey area. Generally the documentation procedures are the same for both approaches, although if the road is extremely visible, full documentation of the reconnaissance phase may not be necessary, depending on the purpose of the inventory.

Corridor surveys are appropriate in a number of management contexts. In situations where the prehistoric alignment and adjacent areas will undergo surface disturbance, an intensive or corridor survey provides information concerning the nature and location of the prehistoric alignment and associated cultural materials. Full documentation is required to provide a basis for the evaluation of significance and determination of mitigation strategies (see below). As discussed earlier, it may also be necessary to follow the intensive or corridor survey approach in order to verify the existence of a prehistoric road in a project area. This might occur when the results of simple reconnaissance efforts are inconclusive.

The location of the survey corridor depends largely on the location of the nearest visible segment or segments, the bearing of those segments, and their relationship to known sites presumed to be road-associated. The corridor should extend a minimum of 1/8 mile on either side of the imaged alignment, for a total width of 1/4 mile. See Figures 8-4, 8-7 and 8-10 (back pocket) for examples of the layout of inventory corridors.

Additional Studies. As an aspect of intensive inventory, it may be appropriate to undertake additional studies directed primarily toward the verification of the road alignment or the facilitation of inventory efforts. A number of different strategies may be considered. Subsurface trenching and profile description, as well as surface stone counts can provide valuable information on the validity of the road as a prehistoric feature, as well as on the nature and degree of construction activities (for a description of these procedures, see Chapter 6). Chemical analysis of the soil (pH testing, phosphate analysis, etc.) as well as a mechanical analysis of soil texture could also potentially yield evidence relating to the nature of soil modifications caused by either prehistoric or historic road construction and use. Monitoring of vegetation changes along the alignment, as well as the acquisition of additional aerial photography (utilizing alternative approaches) may also provide useful information concerning visibility of the road and its location in the landscape.

Areas Having No Visible Segments or Projected Alignments

As discussed in Chapter 4, there appears to be a significant potential that additional road systems will be discovered in the San Juan Basin. For management purposes, it is possible to define what are considered high risk areas, where the potential for encountering a prehistoric road system may be especially high. These areas are defined as follows:

1. Areas between known outliers;

2. Areas in alignment between known outliers and major topographic breaks or locally reduced impediments to travel (e.g., cliff access);

3. Areas between known outliers and outcrops or occurrences of critical resources;

4. Areas along routes which might have facilitated cross-country travel (e.g., along valley bottoms, where multiple passes or

saddles are in alignment);

5. Areas near characteristic road-associated site types;

6. Areas near sites associated with an imaged or ground-visible swale.

In these kinds of situations, research should proceed through all the initial stages of project planning and design, including evaluation of existing data, determination of adequacy of aerial photography, photointerpretation, fieldwork design, and reconnaissance survey. The goal of these efforts should be to determine whether or not there is any evidence of a prehistoric alignment in the project area; to achieve this, all types of relevant information should be explored for their utility. If no indications of an alignment are found during a thorough, systematic reconnaissance survey, there will usually be no need for additional fieldwork. If indications of a roadway are found, and surface disturbing actions are planned for the project area, additional intensive or corridor surveys will probably be appropriate.

The Need for a Comprehensive Approach to Roads Inventory

If viewed functionally, a prehistoric road system can be perceived as a single archaeological site, composed of widely disparate components arranged in a linear fashion over many miles of landscape. The results of this and other studies suggest that in order to understand a road system as a functional entity, it is necessary to collect information from representative areas of the road, which can be combined in a single interpretation.

For the purpose of understanding the role of roads in prehistoric Chacoan society, it is clear that the most efficient and effective inventory plan would be one which approaches the roads in this way. As mentioned earlier, the three unique aspects of roads inventory are the use of a phased approach, the development of a cumulative record, and the constant need to explicitly test the existence of the very resource which is being inventoried. Each of these aspects reinforces the need for a comprehensive approach to roads inventory, which would allow the development of an interpretation of the road as a behavioral phenomenon, rather than as a series of disparate sites and features. The complexity of the identification process for roads greatly increases the need for this type of approach.

A comprehensive inventory effort might involve the development of a joint interagency team, which would be charged with preparing an inventory plan organized by road systems (or major portions of road systems located in critical management areas), rather than by land status or management boundaries. Implementation of the plan would call for assessment of the visibility of the roads over long stretches of the alignment, and evaluation of the need for additional aerial photography or photointerpretation. If necessary, a single set of aerial photography could be flown over large areas, and a single photointerpreter could evaluate the alignment over long distances. Field inventory personnel would be able to compare and contrast long stretches of road, thus sharpening their observational and interpretive skills.

The advantages of this comprehensive approach would accrue to many parties. Land managers would benefit by having an efficient, well-designed program for the completion of an extremely complex inventory process for an important cultural resource. The generation of consistent, comparable inventory results over an interpretable length of road would greatly facilitate the evaluation of individual sites along the road, and would provide a firm, sound basis for the development of mitigation measures. It would provide planning information useful in resource development, and would allow a consideration of roads to be built into surface-disturbing projects at an early stage. An added benefit might be the location of additional outliers or outlier communities as more road systems are discovered and intensively inventoried. (Effective and efficient cultural resource management in the San Juan Basin would benefit greatly by having these communities identified at the earliest possible time.)

Companies and agencies planning multiple surface-disturbing projects in the Basin would also benefit substantially from this approach. A solid inventory base would greatly simplify the process of accommodating prehistoric roads in project design, and anticipating appropriate mitigation measures. Information from a comprehensive road inventory effort could easily be integrated with other types of cultural resource inventory information more amenable to the conventional piecemeal approach. The costs incurred by cultural resource contractors in the course of road inventory for small projects would be substantially reduced if a comprehensive effort had been completed.

The academic community would also greatly benefit from the increased reliability of information produced by a comprehensive approach. If road inventory work increases substantially, a fairly wide margin or error in road identification work is conceivable as the verification process develops. Since many aspects of the interpretation of the Chacoan culture as a whole depend on the configuration of the road system, the most accurate, effective process is the most desirable.

Inventory Reporting Format

In reporting the results of a road inventory project, it is important that information be

accumulated in such a way as to directly address the critical issues of verification and road-association. Sites and features located within the survey area must not only be analyzed as prehistoric or historic sites, they must be interpreted with respect to the prehistoric alignment. A suggested outline for organizing and presenting the results of a prehistoric road inventory is shown in Figure 10-2.

Criteria for Evaluation of Roads and Associated Sites and Features

A critical role of management is to make decisions concerning the preservation and loss of resource values. This job is made easier if explicit guidelines are available defining the full range of important resource information, and indicating which resource values are most significant and have priority when only selective preservation is possible or practical. Many different sets of criteria are in use today which structure a definition of cultural resource significance. Perhaps most important to federal agencies as a group are the criteria for inclusion in the National Register of Historic Places (36 CFR 60.6). The cultural resource program of the Bureau of Land Management follows an additional set of guidelines, set forth in BLM Manual Section 8111, "Cultural Resource Inventory and Evaluation (Upland)," in which significance is expressed in terms of cultural resource management opportunities. The more varied and diverse the opportunities for the "use" of a site, the more significant it becomes. The range of defined use categories includes: management use, current scientific use, socio-cultural use, and future and potential scientific use. In evaluating the sites and features which define a prehistoric road system, the two most important use categories to be considered are potential scientific use, and socio-cultural use.

Potential Scientific Use

Background. The first step in evaluating the significance of a road-associated site is to be sure that it is, in fact, road-associated. For certain types of sites such as visible swales or great houses, this may be a simple process. For other types of sites, however, such as ephemeral architectural sites and material cultural scatters, the determination of road-site association may be more difficult. In future research it is critically important to be explicit about the criteria for road-association, as the concept is currently poorly understood. Results of this project suggest that different types of sites "associate" with the road alignment in different ways: some are simply in close physical proximity with the road, some incorporate the road, some articulate with the road, etc. Before any site is designated as road-associated, evidence for this should be carefully evaluated.

Prehistoric roads can be studied at the regional and local levels. At the regional level the road network is defined as the composite of road systems which once functioned within the Chacoan culture area. The most commonly recognized attributes of the Chacoan road network were discussed in Chapter 3, and will only briefly be reiterated here: 1) roads link sites within the network having Bonito Style architecture (other types of sites are also found along roads but they do not function as "end points"); 2) roads are confined to the greater San Juan Basin; 3) Chaco Canyon is the center of the road network; 4) roads link resource zones; 5) there appears to be zonal variation in the configuration of different road systems within the network (e.g., the road systems to the south are more dendritic); 6) roads may be one aspect of a broader communication system, involving signalling; and 7) in certain instances, parallel road systems are known to occur.

At a more local level, the attributes of individual road systems can be studied. These include: 1) morphological attributes of the road surfaces themselves, visible both from the ground perspective and from the photographed image; 2) features which are thought to have directly facilitated the use of roads, such as stairways and ramps; and 3) other types of architectural and non-architectural sites located on or near the road alignment which relate to its construction or which were conditioned in some way by the presence of the road. These attributes may be thought of as the "component parts" of a road system, as it has been defined for the purposes of this study.

To illustrate, the Penasco Blanco to Ahshislepah Road can be broken down into the following documentable components: 1) the imaged alignments, visible on the aerial photography; 2) the features which facilitated the use of the road, such as the stairs on the cliff-face across from Penasco Blanco, the hand-and-toe holds on the slickrock at Los Aguages, and the "ramp" at the northern terminus; 3) the ground-visible swales; and 4) the associated sites thought to be conditioned by the presence of the road, such as Los Aguages and the various simple masonry concentrations and material culture scatters along the alignment.

Research Issues and Priorities. To a large degree, the potential scientific use of a site stems from the amount of important information which it can contribute to the study of research issues of concern to the professional community. Research issues can be identified at the level of both the road network and the road system. A summary of issues related to the interpretation of the road network is provided in Chapter 3, where issues are discussed in terms of similarities and differences in explanatory models for the network itself. To summarize this discussion, most models appear to interpret

Proposed Format for Road Inventory Reports

1. Environmental setting of the road

    A. Vegetation
    B. Topography
    C. Soils and substrate
    D. History of land use, if pertinent
    E. Basic climatic data

II. Existing archaeological information

    A. General location and brief description of road
    B. Previous work
    C. Known cultural environment of the road
    C. Description of existing data base:
        1. Imaged data base
            a. Description of available imagery (date, scale, contractor, time of year, time of day, total area covered, quality of prints)
            b. Assessment of road visibility
            c. Description of photo-visible segments
        2. Ground-visible segments
        3. Features related to the use or construction of the road
        4. Other associated sites and features

III. Description of project

    A. Location and purpose of project
    B. Statement of research goals
    C. Fieldwork Methodology
        1. Aerial photography used in the field
        2. Definition of Survey Area
        3. Level of inventory
        4. Data collection priorities
        5. Sampling strategies
        6. Recording format
        7. Field techniques
            a. Inventory
            b. Other types of data collection (trenching, stone counts, soils analysis, vegetation monitoring, additional photography, etc.)
    D. Results and analysis
        1. Recorded visible segments
        2. Recorded features related to road use
        3. Recorded sites
            a. Criteria for defining road-site association
            b. Road-associated sites
            c. Non-road associated sites
        4. Additional studies supplementing archaeological inventory

Figure 10-2

IV. Summary

A. Evidence pertaining to road segment or road system verification
   1. Description of factors affecting the visibility of the road
      a. In the imagery
      b. On the ground
   2. Physical characteristics of the road
   3. Evidence of construction
   4. Presence of sites related to road use
   5. Presence of road-associated sites
      a. Types of road-site associations (physical proximity, topographic position, architectural configuration, material culture patterning, etc.)
      b. Types of road-associated sites (cultural and functional analysis)
   6. Density of sites and isolated occurrences with respect to the alignment
      a. Historic materials
      b. Prehistoric materials
   7. Summary of status of verification

B. Interpretation of evidence, application to research issues at the level of:
   a. The road system
   b. The road network

Figure 10-2 (Concluded)

the prehistoric road network as an adaptive mechanism, involving the exchange of materials between resource zones of variable productivity. Issues which are yet to be understood include: 1) the nature of goods exchanged between outlier communities; 2) the nature of trade "links" or interactive patterns between outlier communities; 3) the form of redistribution system which functioned within the network; and 4) the structure, organization and mechanics of the administration of the network.

Information derived from an individual road system could potentially contribute to the understanding of these general interpretive issues, as well as to several more specific issues. A primary issue relating to the interpretation of a road system is the recognition pattern for road-associated sites. In the current study, this problem was approached in two ways (see Chapter 9). In the first approach, it was proposed that road-associated sites would be functionally unique, reflecting specialized activities which took place along the road alignment which were related in some way to the engineering, construction and/or use of the road. Examples of this type of site would include construction camps, signalling stations, shrines, road markers, and "outposts" or sites located near critical resource outcrops. During the course of analysis, it was possible to identify this type of "functional" road association on the basis of physical proximity and site configuration, and to define functional classes which appeared to be consistent across road systems (e.g., Herraduras, Zambullidas, Avanzadas, and directly articulated great houses). When material culture attributes were tested, however, the results indicated homogeneity within individual road systems which appeared to cross-cut previously identified "functional" groups. Future analysis will no doubt provide additional insight on the characteristics of road-associated patterning, if it is not automatically assumed that everything located "close" to a road is road-associated. This is of critical importance in the analysis of future research efforts.

Another broad area of inquiry is the definition of the cultural environment of the roads themselves. The term cultural environment refers here to the number and types of sites which existed in a particular area at the time the road system was constructed. As suggested by the analysis in Chapter 9, variability in the material culture assemblages of outliers along different road systems may offer substantial information about the interpretation of other types of sites along the alignment, such as Herraduras, Zambullidas, and material culture scatters. Information concerning the nature of occupation of an area at the time of road construction can assist in the determination of why those areas were incorporated into the system, and can help define the sequence of construction and occupation of roads and associated sites. Future research should specifically address research questions aimed at defining the nature and extent of prehistoric occupation in road environments.

Also at issue in future research will be the degree to which construction can be demonstrated for peripheral road systems. Additional trench analyses are needed to confirm the extent of actual construction throughout the road network. The results of this project indicate that fairly substantial construction, involving excavation to a depth of 20-25 cm or more, took place in several areas along peripheral systems. If we can infer that road systems were, in fact, continuously constructed, the labor investment implied by the hand-tool excavation of 300-500 miles of road is nothing short of monumental. Any interpretation of roads at the network level would have to allow for the organization of tremendous labor forces for this task alone.

The definition of the function of the roads themselves will no doubt remain a research focus. Although they are thought to have facilitated exchange within a region of diverse environments, the precise nature of this "facilitation" remains to be defined. If we infer that construction was continuous along peripheral systems, the question arises, why was this construction necessary? The most obvious explanation is that construction was performed for the purpose of removing loose A horizon material, to expose the compact B horizon, a surface more suitable for walking. In several instances, however, construction appears to have occurred in situations suggestive of an additional function of delineation (see discussion in Chapter 6). This, as well as the excessive width of the roads, seem to suggest that normal "utilitarian" requirements for prehistoric transportation routes were exceeded. The question of why delineation may have been desirable is intriguing, and suggests a socio-religious function for the roads. Clearly the nature, extent and degree of "utilitarianism" in road construction are important issues in road research, both at the system and at the network level.

Additional work is needed to define more clearly the nature of goods being exchanged in the Chacoan system, and the overall patterns of exchange. Site analysis strategies need to be developed which will directly address the problem of low counts of intrusive ceramic and lithic materials. Roads need to be analyzed as behavorial units for the possible presence of patterning in types and percentages of traded materials. The concept of directionality of trade needs to be addressed at the level of the road network; for this to be done a consistent and highly specific approach needs to be implemented for individual systems under consideration. The idea of the "resource" road needs to be consistently explored for

each of the major systems, with respect to the transport of critical resources such as timber, building materials, and foodstuffs.

In addition to these interpretive issues, there are a number of methodological issues which should be considered in future research. These issues relate to the definition of the kinds of information which can be used to "verify" prehistoric roads, i.e., to demonstrate the presence and age of the prehistoric alignment. A number of strategies have been explored in the course of this and other projects; however, future testing is definitely needed. Although a number of techniques have been tried, the results have been highly variable for different projects and on different road systems.

In general, verification studies fall into one of several groups. Some attempt to verify the alignment using information pertaining to artifact density and distribution. Major issues here revolve around the degree to which areas of high prehistoric site and artifactual density correlate with the prehistoric alignment (see discussion Chapter 9). Indications so far are that this type of correlation does in fact occur, but can vary according to road corridor, type of site, distance from alignment, and amount of "background noise" which pre-dates the road. Future research should explore this correlation on additional road corridors. This type of data is important as independent information supporting the notion that smaller architectural sites and material culture scatters are in some way road-associated.

Another type of verification study involves subsurface testing and surface rock counts as a means of demonstrating construction and age of the road alignment. Additional application of these methodologies, as well as the development of increasingly refined observational techniques, should be given a high priority.

Future research should be carefully planned so as to facilitate the development of a "cumulative" data base which, when compiled, can present substantial evidence for the verification of a road system. More work needs to be done concerning the factors affecting visibility, in particular, vegetational patterning. One potentially fruitful area for future research is the applicability of infrared photography flown at different times during the growing season. Indications are that this could substantially increase road visibility. Perhaps most urgent of all is the need for the expansion of the archaeological roads data base itself. The need for comparative information from other areas along additional road systems is great. No doubt substantial contributions could be made by the careful perusal of existing site records, looking for characteristic patterns of site architecture, configuration, and topographic placement which have been tentatively identified as road-related in this study. In addition, areas having markedly linear patterns of unusually high site densities should be considered suspect. More efficient procedures for locating the roads on the ground should also be explored, including the identification of such subtle types of evidence as isolated out-of-place boulders or "road markers."

Data Collection Priorities. Data collection procedures should be planned so as to provide information suitable for addressing the research issues enumerated above. A high priority should be placed on recording the attributes of the visible swale and its surrounding environment. The Visible Segment Form, or an equivalent form, should be utilized as described in Chapter 6. Extreme care should be exercised in the identification of the alignment or its projection, and wherever possible the type of road-site relationship should be documented for sites considered possibly road-associated. Detailed archaeological information should be collected from sites along the road corridor, sufficient to make statements concerning site function, cultural and temporal affiliation, boundary configuration, material culture attributes, and architectural and structural variability. High priority should be placed on the collection of subsurface information and on performing surficial rock counts in situations where the substrate or surrounding terrain suggest this may prove fruitful.

Socio-Cultural Significance

Navajo. Prehistoric roads and other aspects of Anasazi culture have long been recognized for their socio-cultural significance in the traditions and legends of Navajo groups. Generally speaking, according to the Navajo origin legend present-day society exists in the fifth world. Remnants of the previous four worlds remain in the fifth, including the ruins of the Anaasa'zi' or ancient enemy. The decline of the Eastern Anasazi system in the mid-twelfth century AD marks the end of the fourth world.

The massive remains of the Anasazi buildings are very much a dominant aspect of the contemporary landscape of the San Juan Basin. To many Navajo, the presence of the ruins are reminders of the internal strife which they believe "tore apart" the fourth world (Fransted 1979). The ruins were intended to be like natural aspects of the landscape, and as such represent balance and harmony. Anasazi ruins are considered to be spiritually unsafe places (Fransted 1979:4) and intentional disturbance of these places is not sanctioned by Navajo society.

Unfortunately, only limited work has been attempted to systematically document the place of Anasazi ruins in the Navajo origin legends (Fransted and Werner 1974; Fransted 1979; Van Valkenburgh 1941, 1974; York 1982).

Although the Navajo people ultimately inherited the San Juan Basin, they are not descended from the Anasazi. The origin legends suggest that the Navajo were present, however, during the decline of the Chaco system and much information pertinent to the reconstruction of historic events may be present in the chantways. Although "roads" are an aspect of Anasazi remains recognized by the Navajo (Judd 1954:346), very few individuals today have direct knowledge of these features. Persons with specific knowledge of the roads are generally religious practitioners who would not divulge such information in a casual interview. This type of information must usually be purchased, similar to purchasing legal information in Anglo society. Further, this type of information can only be purchased during a specified time of year.

It is now understood that many of the Eastern Anasazi great houses figure as occupied places in the chantways, and now maintain sacred or semi-sacred status. Navajos agree that the "roads" were built by the Chaco people (York 1982:3-270-271; Judd 1954:346) and that they served to connect distant locations with Chaco Canyon. One informant referred to the roads as 'atiin and described them as trenchlike in appearance and used by the Navajo for long-distance travel (Fred York 1981: personal communication).

Although collection of ethnohistoric information was not an aspect of the Chaco Roads Project, there was occasional opportunity to discuss the concept of prehistoric roads with individuals whose families had resided in the vicinity of these features for many generations. One such incident was especially interesting. The informant met the crew as they stood within a segment of the South Road which is not presently ground-visible. After greetings were exchanged and the crew's presence explained, the individual was not in the least perplexed but rather confirmed that the crew had accurately located the prehistoric feature. The individual stated that the "road" could be followed into Chaco Canyon and that during early morning and late evening light it could be seen continuing to Kin Ya'a. The informant implied that knowledge of the roads was restricted to a few individuals and that there were others who knew much more than himself. He stated that as a child he was not allowed to play in the vicinity of the prehistoric South Road.

Obviously, much more oral historical information could and should be collected on the roads. The significance of these features in the Navajo origin legends is not fully understood, but could be very informative both from the standpoint of reconstructing events in the chantways and analyzing the functions of roads in Anasazi and Navajo societies.

Anglo. Much of the history of roads from the Anglo perspective is documented in the archaeological literature summarized in Chapter 3 and Appendix A. Additional information from Anglo settlers in the Basin is also available. The earliest oral historical information available today dates to the 1930s. The father of one informant interviewed for this project was a stock buyer in the Basin during the great drought of the 1930s. He was highly mobile and spent time both north and south of the Canyon. The informant recalled that swales of the prehistoric roads were deep enough to concentrate water and that annuals in the roads grew vigorously, much as they do in a bar ditch. Because of the general denudation of the landscape at that time, the contrast was marked and the features could be easily followed. This was particularly true of the roads converging on Pueblo Alto. The informant stated that the North Road was known as the "Salmon Road" in the 1930s. This individual also maintained that he remembered features with characteristics similar to the roads in the Basin flanking the Malpais south of Grants.

Mitigation of Effect

If cultural resource values are identified which may be affected by the implementation of a proposed project, recommended strategies for considering these effects are described in a document called the Mitigation Plan. The term mitigation, in this case, refers to the "lessening of effect" of the project upon the identified cultural resource values. Three basic strategies generally considered in the Mitigation Plan are: 1) no additional data recovery recommended (existing data sufficient); 2) additional data recovery recommended; 3) avoidance, or in situ (in place) preservation recommended.

No Additional Data Recovery Recommended

For some road-associated sites, the inventory procedure alone may have recorded sufficient information so as to make additional data recovery unnecessary. Even though additional fieldwork may not be needed however, it is important that these sites be analyzed and evaluated from the standpoint of their potential to contribute information to the understanding of prehistoric roads. This can be done by incorporating the analysis of these sites into a reporting format which directly addresses the interpretation of the road or road system as a composite of road-associated sites. A suggested outline for this type of report can be found in Figure 10-2.

Additional Data Recovery Recommended

As noted earlier, one of the primary goals of this project was to define the information potential of prehistoric roads and road systems. This is the first step in determining whether additional data recovery is appropriate, and if so, what techniques should be used. In general the results of this project suggest that the actual road

surfaces themselves, at least as they occur away from major sites in peripheral areas of the Basin, are limited in terms of the variety of information they contain. This makes data recovery, in most instances, a fairly straightforward process.

Data recovery strategies should be directed towards addressing the major research issues identified earlier in this chapter, including the verification of the road, road-site associations, dating of the road, road construction and engineering, and the nature and mechanisms of interaction. At this time additional studies not completed during the inventory phase should be considered (including subsurface trenching and profile description, stone counts, soil analysis, vegetation monitoring and additional aerial photography). Standard techniques of data recovery, including the collection, testing and full excavation of road segments and associated sites and features may be called for; however, these should be carefully planned to maximize information concerning questions critical to roads interpretation.

In Situ Preservation

In general, cultural resource sites are considered for preservation if they meet one or more of the following criteria: 1) they have potential value for public interpretation or education; 2) their scientific information content is of sufficient complexity as to suggest that future analysis techniques may yield additional information not obtainable by current technology; 3) they represent a classic example of a particular architectural form; and 4) they have particular socio-cultural values.

In the case of prehistoric roads (including swales and associated sites and features), the following is a list of types of sites which could potentially be considered suitable for in situ preservation:

1. Structural sites which exhibit Bonito Style architecture;

2. Sites consisting of markedly linear "cigar-shaped" material culture scatters which coincide with the visible swale;

3. Sites which could potentially contain areas where the road (as indicated by a visible swale) and the site directly articulate, and where this articulation appears to be intact;

4. Sites which, based on evaluation of their topographic position and substrate characteristics, hold promise for the preservation of evidence of construction;

5. Sites which conform to the criteria for Herraduras, Zambullidas, or Avanzadas (see Chapter 9);

6. Sites in which the road swale, or the swale-site articulation is especially visible;

7. Sites which are identified by Native American groups as having special religious or social significance.

Management Implications and Approaches

Information collected in this project can now be applied to guide management policies and decisions as specific situations arise which may affect the roads resource base. A number of policies should be instituted which are consistent with conventional approaches to cultural resource management. All surface-disturbing projects administered or approved by the BLM should be reviewed for possible impacts on prehistoric roads, following the procedures presented in this report. Early project planning and environmental assessment documents should evaluate potential impacts upon known or projected prehistoric road alignments. Existing land use plans, activity plans and project plans should be evaluated for previously unrecognized potential impacts on prehistoric roads. Additional studies are needed which address the roads as complete entities rather than as composites of individual sites. Significant road segments or road-associated sites should be evaluated for inclusion in the National Register of Historic Places, and should be considered for in situ preservation when appropriate. Data recovery procedures should continue to be refined and tested during future studies. Existing site files should be scrutinized for possible road-associated sites.

In addition, it is recommended that the Bureau of Land Management, if possible in conjunction with other agencies such as the Bureau of Indian Affairs, the Navajo Tribe, the National Park Service, the State Historic Preservation Bureau, and the Laboratory of Anthropology, assume an active role in facilitating future roads research. This might involve not only the joint funding of inventory studies (as described earlier in this chapter) but also a cooperative approach to assure that future roads research will result in the development of a consistent, compatible data base.

Communication with the cultural resource contracting community should be initiated to assure that field personnel are alerted to the need for addressing prehistoric roads in the course of their everyday contracting work. Terminology, data recording formats and inventory procedures should be evaluated to assure compatibility (as opposed to standardization) of the information collected. Formats for computer storage of information pertaining to the roads data base should be assessed and utilized on a broad scale. Maps showing the "imaged" data base as currently known should be made easily

available to the contracting community. New aerial photography of the major road systems should be flown, utilizing techniques designed to maximize road visibility. Several sets of existing photography (most importantly the 1930s SCS and 1950s-1960s USGS photography) should be made available for temporary loan to roads researchers.

The rapid pace of energy development in the San Juan Basin places the burden of developing new management policies for prehistoric roads squarely on the shoulders of the major cultural resource management agencies. The cooperation of these agencies with the professional community will be critical in the future protection of this important resource.

Chapter Summary

A comprehensive management plan has been presented which incorporates information and recommendations from previous chapters; it is intended to provide a general framework for structuring inventory and data collection activities, and to establish a basis for site-specific recommendations on preservation and data recovery options. The success of future road management will depend to a large degree upon the cooperation of cultural resource management agencies and the professional community in developing new techniques and policies for the management of prehistoric roads.

CHAPTER 11

CHAPTER 11

SUMMARY AND CONCLUSIONS

The Chaco Roads Project Phase II

In the summer of 1982, the Bureau of Land Management fielded Phase II of the Chaco Roads Project. The objective of this phase was the application of methodology developed in Phase I to the evaluation of Chacoan roads thought to cross prospective coal leases in the southern San Juan Basin. The roads subject to the most intensive investigation were the South Road, Southeast Road, and the Kin Ya'a to Ruby Wells Ranch Road (see Figure 4-1). A number of other prehistoric roads, however, were examined to establish comparability of roads in different areas, assess the validity of previously imaged roads, and provide a starting point for reconnaissance activities. Among these were the: Coyote Canyon Road, Muddy Water complex, Andrews to Casamero Road, Haystack Ruins complex (especially the Haystack Northwest Road), Kin Nizhoni complex, Chacra Face Road, Padilla Well Road, and the hypothetical Kin Bineola to Bee Burrow and Kin Ya'a to Kin Bineola Roads. In addition, the relationship between roads and great houses was examined at San Mateo, Kin Nizhoni, Kin Klizhin, Haystack, Andrews, Casamero, Muddy Water, Kin Ya'a, Peach Springs, Standing Rock, Bee Burrow, Kin Bineola, Bluewater Springs, Guadalupe, Tse Lichii, and Tse La Vie. Roads were examined by photointerpretation, aerial reconnaissance, and field studies. New low sun angle aerial photographs of the Southeast and Kin Ya'a to Ruby Wells Ranch Road were flown at scales of 1:12,000 and 1:24,000. The South Road was flown at a scale of 1:12,000. Field work included both reconnaissance and intensive inventory of selected locations. The project was administered by the Albuquerque District Office, under the supervision of John Roney. Fred Nials was principal investigator, supported by John Stein and Daisy Levine.

The results of Phase II included development of a specific set of recommendations concerning the need for additional work on Chacoan roads located inside the boundaries of the coal leases under investigation (the Lee Ranch, Hospah, Crownpoint East and Crownpoint Northeast leases). In addition, the study resulted in the refinement of many of the conceptions of roads and road-site relationships developed as a result of the Phase I study.

One result of the Phase II study was the identification of possible earthen architecture in road-associated contexts. These "earthworks," some of which have been traditionally described as trash mounds or construction middens by previous investigators, were found in circumstances which strongly suggested a close association with the prehistoric roads. Three types of earthworks were tentatively identified: platform mounds, mounds with no retaining structure (usually rounded in plan view), and linear mounds (parallel to roads). To date, such features have been found in association with Bonito Style great houses in numerous locations on the periphery (including Kin Ya'a, Haystack, Muddy Water, Standing Rock, and Lake Valley), suggesting that they may represent an important characteristic of the Chacoan road network. Additional studies are needed before these features can be adequately assessed. If their association with prehistoric roads is confirmed current perceptions of the scale and magnitude of labor investment implied by the road network would be considerably affected. It is recommended that all great house locations be re-evaluated with respect to the issues of mound composition and placement along prehistoric roads.

Additional work on the roads has also led to a re-assessment of other aspects of Bonito Style architecture. Evaluation of great houses associated with roads suggests that the McElmo phase of Bonito Style architecture, as it is currently known, appears to be a pan-Eastern Anasazi phenomenon. This is indicated by the plan and distribution of structures such as Bee Burrow, Kin Kletso, Allentown, Tse Lichii, Greenlee, Lake Valley, Twin Lakes and others on the Basin floor. There is suggestive evidence that the tower kiva form, also generally believed to be a late architectural manifestation, may either predate or exist coevally with the formalization of the road network (e.g., Lower Greenlee, Upper Kin Klizhin).

Perceptions concerning the association of simpler architectural forms with road alignments have also been refined, although many uncertainties remain. The significance of Herraduras as a site class and road-related feature as determined in Phase I was largely confirmed and expanded in Phase II. Examination of 25 Herraduras in 15 locations reaffirms the integrity, patterning and consistent association with road alignments of this site class. The validity of the Zambullida and Avanzada classifications, however, remains problematic.

In addition to the above, much information pertaining to specific road segments and systems was collected, the most important of which will be briefly mentioned here. The existence and prehistoric age of many photointerpreted road segments in the vicinity of outliers in the southern San Juan Basin, Dutton Plateau and Red Mesa Valley areas were verified through ground examination. However, although an Herradura was found at the Ram's Pasture location approximately 4.5 miles south of Greenlee Ruin (see Figure 4-1), no other physical or archaeological evidence was found to verify the existence of a formalized Southeast Road

Figure 11-1. Oblique aerial photo showing a segment of the Penasco Blanco to Ahshislepah Road, north of Ahshislepah Canyon near Black Lake.

between Greenlee and approximately 2 miles north-northwest of San Mateo Ruin. The existence of verified segments at either end of this projected road suggests the presence of a former route of travel in the general area, however ground and photo examinations failed to locate the alignment precisely.

The Kin Ya'a to Ruby Wells Ranch Junction Road was also not verifiable as a prehistoric feature. The "road" is visible as a photolineation, and possesses many photo characteristics of a prehistoric feature. However, the almost total absence of prehistoric artifacts, the presence of multiple parallel historic roads in some locations, and subtle photoindications of the road diverting locally for dunes and other features, all suggest that this road is an historic feature.

The alignment of the Penasco Blanco to Ahshislepah Road was tentatively extended several miles to the northwest, beyond its supposed terminus at the "ramp" in Ahshislepah Canyon. Previously unrecognized road segments were observed near Black Lake during Phase II aerial reconnaissance under low sun conditions, and were photographed from the oblique aerial perspective (see Figure 11-1). These segments have not been examined on the ground as of the present. The actual northern terminus of this road is yet unknown; however the projected alignment passes through several PRLA and competitive coal leases, in an area of strippable coal reserves.

The northern extension of the Penasco Blanco to Ahshislepah Road is especially exciting because it has been sought for many years. Its recent discovery carries with it the lesson that roads can often be discovered only under optimum conditions of lighting and perspective, and that their visibility is subtly influenced by factors at present only poorly understood.

Much of the information collected during the Phase II project is currently on file at the Laboratory of Anthropology in Santa Fe. Additional information may be obtained from the Albuquerque District Office of the Bureau of Land Management. A Phase II report has been prepared, and will be made available for distribution; additional methodology and management conclusions were developed in this study.

Conclusions

In keeping with the project goals and scope discussed earlier, issues relating to methodology and technique are among the most important conclusions of this report. Perhaps most importantly, Chacoan roads may now be viewed as a cultural resource which can and must be incorporated into the cultural resource management programs of land managing agencies and professional individuals and institutions. We have demonstrated that prehistoric roads exist as a visual and archaeological resource in widely diverse areas of the San Juan Basin and its periphery, outside the "halo" of

Chaco Canyon and its large towns. We have developed methodologies of exploring for roads, locating them on the ground, and inventorying their characteristics, and have demonstrated the efficacy of these techniques in practical application. We have developed means of differentiating prehistoric roads from historic roads, and of identifying, in some situations, whether or not construction has occurred. Though not all-inclusive, we have offered some explanations for the most frustrating and confusing aspect of roads, their elusive and changeable visibility. A classification system for the physical characteristics of roads was developed, to assist the observer in effectively isolating important information to be collected in the field. We have explored the information potential of small, isolated road segments, and placed them in the context of an overall management approach. We have attempted to develop and clearly state working definitions for terms describing the various characteristics and attributes of roads and roads research. Based on these efforts, we have concluded that prehistoric Chacoan roads do exist today as a tangible resource, and that methods are available by which they can be effectively and accurately studied on a wide scale.

We have also arrived at a number of conclusions concerning the nature of roads and their place in Chacoan society, although the limited extent of our data collection activities, at least in Phase I, suggests that these should be regarded as propositions to be tested. Specifically, our observations indicate that a network of roads having relatively uniform overall characteristics did exist in at least some parts of the San Juan Basin. Distribution of Bonito Style sites as well as smaller structural sites and material culture scatters along the road alignments showed patterned association, as was expected. Although there was no evidence that roads served to facilitate extensive domiciliary occupation of the hinterland areas between major sites, site densities generally tended to increase in the vicinity of the roads. The results of material culture analysis from Bonito Style sites as a group were inconclusive, although smaller sites recorded along at least two corridors consistently displayed what might be considered a non-domiciliary pattern of material culture traits. No clues as to the actual tools used in road construction were found, in either ceramic or lithic assemblages, suggesting that excavation along the road was accomplished by means of wooden tools, baskets, hides, and/or by hand. Other than ceramic vessels, no suggestion as to the nature of items transported along the roads (if any) was derived from our observations.

The activities which took place along the roads remain a mystery. The observation of several "cigar-shaped" Ceramic/Lithic scatters, consisting of extremely dense and elongate concentrations of predominantly ceramic material, provide perhaps our most promising clue. In general, however, density of ceramic materials along the alignment does not suggest intensive or extended use of the roads. Dating of the roads (i.e., dating of sites thought to associate with the roads) suggests they are a late-eleventh to early-twelfth century phenomenon, and did not remain in use after approximately 1150-1200 AD.

Directions of Future Study

The combined results of Phase I and II investigations have immeasurably increased our knowledge of Chacoan roads and have provided a vehicle for the systematic study and management of such roads in other areas. Despite these advances in our understanding, there is still much which remains to be learned about Anasazi roads in the Colorado Plateau.

Although the verified extent of the roads was greatly expanded in the areas south of Chaco Canyon, knowledge of the actual extent of the Chacoan road network still remains fragmentary. Areas at the margins of the Chacoan realm are of critical importance, for they potentially provide many clues about the relationship of the Chacoan society to other surrounding contemporary non-Chacoan populations.

It can be shown that a degree of engineering was utilized in the layout of the roads; engineering methodology, however, is incompletely understood as of the present. The relationship and possible engineering significance of some site types such as "signalling stations" and Windes' Shrines to roads is unclear. Although it is believed that at least some great houses and roads were emplaced contemporaneously as an aspect of Bonito Phase activities, the factors that controlled the alignment of the roads and the position of the great houses are not understood. In some instances the roads appear to have been located, in part, in consideration of older, presumably pre-formalized-road sites.

It has been demonstrated that many portions of the Chacoan roads were constructed. It is possible that much, though not all, of the construction recognized to date may be in part the product of organized maintenance of the roads. The amount of labor required for the construction and/or maintenance of the roads is incompletely understood. Development of such an understanding is of significance in evaluation of the human resources of the Chacoan society and the social organization necessary for completion of such a major project.

The function of the roads is still unclear. There is no question that most of the roads connected Chacoan great houses, but for what purpose? Although a variety of functions possibly served by the roads have been postulated, including communication, transport of construction materials,

transport of trade goods of other types (e.g., turquoise, shell, lithic materials, ceramics, foodstuffs, and other exotic materials), the fact remains that with the exception of ceramics, no durable artifacts have yet been found on the roads that provide an indication of transport of specific items. This lack of durable items may suggest transport of perishable goods, although this must remain in the realm of intuition and speculation. Carefully designed excavation of Chacoan sites may provide much information about the function of roads.

Other aspects of the Chacoan roads remain enigmatic. The relatively "sudden" appearance of formalized roads has no known explanation as of the present, nor does their equally rapid disfunction. Cessation of construction and maintenance of the roads in the Basin is clearly related to the demise of the Bonito Phase; material culture on the roads suggests that the roads were seldom utilized by post-Bonito Phase occupants of the Basin floor.

Ethnographic studies offer the potential of providing information about the roads. Similar Navajo stories about the roads being "tunnels" along which the Anasazi traveled in safety were related in widely separated areas on the Basin floor. There is clearly a body of information pertaining to the Chacoan roads which is largely untapped at the present time.

Many of the presently unknown aspects of the Chacoan roads will probably never be known. Future study of the Chacoan phenomenon should, however, consider the roads as a major element of the Chacoan society, and research objectives should be designed accordingly, oriented toward the solution of the above-cited and other unknown aspects of Chacoan roads.

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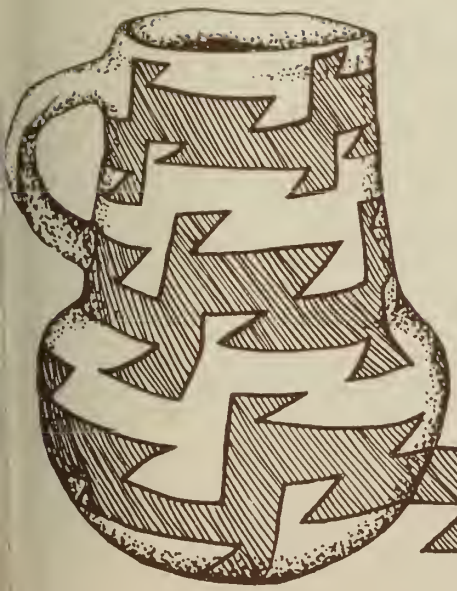


GLOSSARY

GLOSSARY

A HORIZON - Normally, the surface horizon of a soil, characterized by organic accumulation and eluvial (leeching) processes. Compare to B horizon.

ADOBE-STONE - As utilized in this study, adobe-stone refers to an admixture of adobe and stone used in the construction of border elements, containing at least 50 percent adobe.

AEOLIAN - 1) The erosive action of the wind. 2) Deposits which are the product of the transporting action of the wind. Contrast to alluvium and colluvium.

ALIGNMENT - The directional trend of a prehistoric road, as established by connection of road segments and/or road-associated sites or features. The alignment consists of ground- and photo-visible segments as well as intervening areas where the roadway is not visible (projected alignments).

ALLUVIAL FAN - A cone-shaped accumulation of alluvium deposited where drainages change gradient.

ALLUVIAL TOESLOPE - That portion of the landscape where alluvial processes dominate. Valley bottoms. Compare to colluvial footslope, convex creep slope, and fall face.

ALLUVIATION - The deposition of sediments by streams.

ALLUVIUM - Sediments deposited by streams. Contrast to aeolian deposits and colluvium.

ANTICLINE - Bedrock that has been folded convexly upward. Contrast to monocline and syncline.

ARCHAEOLOGICAL ENVIRONMENT (of a road) - Archaeological remains indicative of the prehistoric settlement and land use patterns of the countryside through which a road passes, regardless of chronological affiliation. Contrast to cultural environment.

ARM FILE - The Archaeological Records Management System, a computerized file of archaeological site information maintained for the State of New Mexico by the Laboratory of Anthropology in Santa Fe.

ARROYO - An incised stream channel, usually of an intermittent or ephemeral stream, and usually having vertical banks of alluvium or other unconsolidated material.

ASSEMBLAGE - The set of artifacts found on a particular site, usually characterized in terms of relative frequency of various types of artifacts.

AVANZADA - A squared rectangular building which includes one to four rooms made of simple coursed masonry and/or jacal, situated on an elevated low butte or badland pinnacle adjacent to and elevated somewhat above the road alignment. Compare to field house and small house. (Literally, an "outpost.")

B HORIZON - In a mature soil the B horizon is normally characterized by illuvial (translocated) clays and/or soluble salts, usually redder than horizons above or below. Compare to A horizon.

BEARING (of a road) - The compass direction taken along a visible or projected road alignment.

BERM - A broad, low, linear ridge of earthen and/or rubble materials occurring along road margins.

BLOCKED-IN KIVA - A circular chamber five to nine meters in diameter, built within a large square surface room which is incorporated into a roomblock. These features are a primary characteristic of the Bonito architectural style. Synonymous with housed kiva.

BLOWOUT - A general term for various shapes and sizes of depressions formed by wind erosion on a pre-existing dune or other sand deposit.

BONITO ARCHITECTURAL STYLE - A style of architecture dating between 900 AD and 1150 AD characterized by distinctive core-and-veneer masonry, blocked-in kivas, and large rooms. This architectural style was typically employed for non-domiciliary structures such as great houses, great kivas, and some road-related features.

BONITO CAIRN - A massive cairn over one meter in diameter and several meters in height, believed to have been constructed by Anasazi. Also see cairn.

BONITO PHASE - A term coined by Gladwin (1945), used in this report to identify the entire range of Chacoan activity between 900 AD and 1150 AD, particularly the period characterized by Gallup-Escavada style mineral painted ceramics, ca. 1050 AD to 1150 AD.

BORDER ELEMENTS - Modifications of the landscape at the margins of constructed roads.

BOWL SHERDS - Sherds with polish, slip, or decoration on their concave surfaces. Contrast to jar sherds.

BREACHED ANTICLINE - An anticline in which the central portion of the fold has been eroded away.

BULK DENSITY - The specific gravity of a porous sediment or soil.

CADASTRAL - Pertaining to the legal boundaries of subdivisions of land, such as Township and Range, Section, and quarter Section.

CAIRN - A low circular pile of stones, seldom exceeding a meter in height or diameter. Also see Bonito cairn.

CALICHE - 1) A soil horizon cemented by porous calcium carbonate. 2) The calcium carbonate itself.

CAMBIC HORIZON - An altered horizon, as indicated by structure, color, gley features, clay formation, or evidence of removal of carbonates.

CAUSEWAY - A raised roadway.

CENTERLINE - The center of an imaged, projected, or ground visible alignment.

CERAMIC/LITHIC SITE - A site consisting of mixed lithics and ceramics, with ceramic material most numerous. Compare to Ceramic site, Lithic site, and Lithic/Ceramic site.

CERAMIC SITE - A site consisting almost entirely of pottery sherds. Compare to Ceramic/Lithic site, Lithic site, and Lithic/Ceramic site.

CERAMIC TALLY - A simple count of the number of sherds of various types and/or vessel forms which occur in a given area.

"CIGAR" - An elongate Ceramic/Lithic scatter centered on and in Direct Association with a prehistoric road alignment.

COBBLE - A rock fragment between 64 and 256 mm in diameter. This term is also used to describe stream-rounded stones of approximately this size or larger.

COLLUVIAL FOOTSLOPE - That portion of the landscape characterized by redeposition of material by mass movement and surface wash, fan formation, transportation of material, and creep. Typical slope angles of colluvial footslopes are 4 degrees to 26 degrees. Compare to alluvial toeslope, convex creep slope, and fall face.

COLLUVIUM - A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff, brought there chiefly by gravity and surface wash. Contrast to aeolian deposits and alluvium.

COLOR DENSITY SLICER - A machine incorporating a black-and-white closed circuit television system which measures density (or gray scale) on a photograph. Arbitrary colors assigned on a color monitor are based on density level. This technique is useful because the human brain can better distinguish different colors than different shades of gray.

COMPONENT - A temporal, cultural, and/or functional element of an archaeological site which can be identified or distinguished from other such elements. In this report the term component refers primarily to temporal distinctions.

COMPOUND - An unroofed masonry enclosure, room-sized (1.5 m by 3 m) or larger, with or without a doorway.

COMPOUND MASONRY - Masonry made by laying two parallel rows of stones which interlock in the wall interior.

CONSISTENCE - The degree of resistance of soil aggregates to deformation as measured in three states: dry, moist, and wet.

CONSISTENT TOPOGRAPHIC POSITION - The repeated occurrence of a particular class of archaeological site in a specific topographic setting near prehistoric roads. Compare to Simple Physical Proximity and Direct Association.

CONSTRUCTION - As utilized in this report, construction refers to any intentional modification of the land surface for the purposes of developing a land route of travel, involving removal, addition, or rearrangement of materials including earth, stone, timbers, and surface plants or debris. Also see engineering.

CONVEX CREEP SLOPE - That portion of the landscape, usually above steeper slopes, which is characterized by soil creep and terracette formation. Compare to alluvial toeslope, colluvial footslope, fall face, and transportational midslope.

CORE-AND-VENEER MASONRY - A style of massive masonry having a rubble or rough stone core, faced on both sides by carefully selected or shaped tabular stones, skillfully laid to form a smooth veneer.

CORRIDOR - A delimited area within which a prehistoric road is believed to occur. The corridor may be defined on the basis of interpolation between known points (e.g., photointerpreted or ground-visible road segments, road-associated sites) or on the basis of projection of trend from a known point (e.g., a single road segment, road-associated site).

CORRIDOR SURVEY - A systematic survey over an area defined by an arbitrary distance on either side of the centerline of a road or projected alignment.

COURSED MASONRY - Articulated masonry in which the stones are arranged in approximately horizontal rows with clearly visible layers of application.

CUESTA - An asymmeterical ridge in which one slope is long and gentle (usually less than approximately 10 degrees, generally corresponding with the dip of the bedrock), and the other slope is steep.

CULTURAL ENVIRONMENT (of a road) - The prehistoric settlement and land use patterns of the countryside through which a road passes, thought to exist during the time of road construction and use. Contrast with archaeological environment.

CURB - Low, narrow, linear features of stone or adobe, or a combination of the two. Curbs are: 1) less than two courses or 25 cm in primary height if composed of stone, 2) less than 25 cm in primary height if composed of adobe or adobe-stone, 3) less than 50 cm in width regardless of composition, 4) parallel to the linear axis of the road, and 5) never composed of core-and-veneer masonry. Contrast to wall.

CUT PROFILE - A type of longitudinal profile in which the higher points in the road topography have been excavated.

CUT-AND-FILL PROFILE - A type of longitudinal profile in which higher points in the road topography have been excavated, and lower points have been filled in, producing an alternately excavated and elevated longitudinal profile.

DATA RECOVERY - Intensive collection of data above and beyond detailed recording. Data recovery generally implies surface collection, subsurface testing, or full excavation.

DATES

BEGINNING - See Ceramic (unweighted) and Ceramic (weighted) dates.

CERAMIC (UNWEIGHTED) - A series of computer-generated dates based on the range and mean dendrochronological dates of each ceramic type (see South 1977 and Gomolak 1980). Three types of unweighted Ceramic dates were generated for this project: 1) Ceramic Mean date--a date generated by assigning the mean dendrochronological date of its type, then averaging these values for all sherds on a site or series of sites; 2) Ceramic Beginning date--a date determined by subtracting one standard deviation from the Ceramic Mean date; 3) Ceramic End date--a date determined by adding one standard deviation to the Ceramic Mean date.

CERAMIC (WEIGHTED) - A series of dates generated in the same manner as Unweighted Ceramic dates, except that the mean dendrochronological date for each type is weighted by the inverse of its span, thus emphasizing short-lived, time-sensitive types. As for Unweighted Ceramic dates, three types of Weighted Ceramic dates were generated: 1) Weighted Ceramic Mean dates, 2) Weighted Ceramic Beginning dates, and 3) Weighted Ceramic End dates.

GROUP - A date assigned to an analytical group of sites which is calculated by dividing the sum of all weighted or unweighted ceramic dates for sites in the group by the total number of sites in the group.

MAXIMUM - The latest date of a ceramic type.

MINIMUM - The earliest date of a date of a ceramic type.

OCCUPATION - Dates based on relative proportions of plain and corrugated types, relative proportions of local decorated pottery types, and the presence of intrusive wares (see Marshall et al. 1979).

SPAN - The period of time bracketed by minimum and maximum dates of a ceramic type.

DEEP - In reference to transverse profiles of prehistoric roads, "deep" refers to roads having negative topographic expression exceeding 35 cm.

DEFLATION - The removal of material from a land surface by aeolian processes.

DETAILED RECORDING - Recording of important attributes of a site or feature, generally through surface observation.

DIKE - A tabular body of igneous rock that cuts across the structure of adjacent rocks or intrudes massive rocks.

DIP - The angle at which a stratum or any planar feature is inclined from the horizontal.

DIRECT ASSOCIATION - Coincidence, cotermination, or articulation between a road swale or projected alignment and the boundaries or features of an archaeological site. This term implies a functional, temporal, or morphological relationship between the road and the site. Compare to Consistent Topographic Position and Simple Physical Proximity.

DODGING - A process used in printing aerial photographs which mutes shadows and reduces overall contrast.

DOGLEG - An angular, rather than curved, turn or change in the bearing of a road.

DOMICILE - As used in this report, domicile refers to a small Anasazi structural site, generally 3 to 10 rooms in size, often with an associated subterranean kiva, and believed to have been used primarily for habitation. Contrast to fieldhouse and great house.

DOUBLES - See parallel roads.

EARTHWORK - A large deliberately constructed mound sometimes attaining a height of two meters or more, usually built near a great house. Earthworks may contain some trash, but their matrix includes little or no ashy soil, a characteristic which distinguishes them from formal middens.

EDAPHIC - Pertaining to the soil, especially with respect to its influence on organisms. Soil factors.

EDGE ENHANCER - A black-and-white television monitor which superimposes positive and negative images of a photograph. Slight electronic offsetting of the two images makes linear features more prominent.

ELEVATED KIVA - A kiva built on a natural promintory or on an artificial platform, so as to occupy the highest part of a structure. Contrast to tower kiva.

ENGINEERING - As utilized in this report, engineering refers to the conception and planning of a route of travel to a known destination. This can include the survey and demarcation of a route of travel prior to or during construction.

FACIES - A lateral subdivision of a stratigraphic unit.

FALL FACE - Locally steepened area, usually bedrock, where colluvial actions predominate. Slopes of 45 degrees to 80 degrees are common. Compare to colluvial footslopes, alluvial toeslopes, and convex creep slopes.

FAULT - A fracture or fracture zone along which there has been displacement of the sides relative to one another.

FIELDHOUSE - A small, usually one room, structure near agricultural soils. Fieldhouses are believed to have been used for storage or temporary habitation associated with farming activities. Compare to domicile, Avanzada and small house.

FIELD WORK GUIDELINES - A set of procedures for physically locating and documenting cultural resources on the ground.

FILES STORAGE - The accumulation of a comprehensive data base to facilitate future analysis; also, the manner in which it is organized for future retrieval.

FILL PROFILE - A type of longitudinal profile in which lower points in the road topography have been filled in to produce a more level roadway, elevated above ground surface.

FIRST-ORDER PHOTOCLASSIFICATION - A reconnaissance stage of photointerpretation in which lineations are located. Only the most obvious differentiations of lineations, usually between natural and cultural features, are made in this stage of photointerpretation. Contrast to second-order photoclassification.

FLAGGY - Referring to sandstone strata from 10 to 100 mm thick.

FORMALIZATION - Deliberate construction which lends architectural emphasis in varying degrees to features which are normally mundane, such as trash mounds and routes of travel.

FUNCTIONAL GROUP - A group of sites related to one another by similarities in site function as indicated by architecture, internal features, topographic position, artifactual assemblage, or other evidence (e.g., Ceramic site, Lithic site, Herradura).

GEOMORPHIC PROCESSES - Those geological processes operating to modify the surface of the earth.

GEOMORPHOLOGY - That branch of geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of landforms.

GRAB SAMPLE - Usually a sample which consists of elements selected indiscriminately, without conscious bias, but also without reference to any systematic strategy. In this study however, grab samples almost always equate with 100 percent sampling of surface-visible specimens.

GREAT HOUSE - A multi-room surface structure built in the Bonito architectural style. Great houses always incorporate a blocked-in kiva into the architectural matrix, and typically exhibit large rooms with high ceilings, tower kivas, elevated kivas, enclosed plazas, and articulation or association with roads and earthworks. Construction is universally core-and-veneer masonry which reduces to form a rubble mound of massive proportions. These structures are thought to be non-residential.

GREAT KIVA - A semi-subterranean circular chamber 10 m or more in diameter. After 1000 AD great kivas are usually characterized by surface alcove rooms placed at one or more of the cardinal directions, rectangular floor vaults, and roofs supported by four large, free-standing pillars. The presence of a great kiva suggests a moderate to large community, as they are presumed to perform an integrative social function.

GROUND TRUTHING - Ground examination of features observed from the air or on aerial photography in order to determine their true nature and origin.

GROUND VISIBILITY - As applied to this study, the degree to which a linear feature is visible from the ground perspective.

HEMATITE CONCRETION - A nodular or irregular concentration of authigenic iron oxide in sedimentary rocks which develops by localized deposition from solution. The concentration is harder than the enclosing rock and more resistant to erosion.

HERRADURA - A low "C," "D," or "horseshoe"-shaped enclosure with simple to compound coursed masonry walls up to 1 m in height and up to 7 m in diameter. Herraduras are always located adjacent to prehistoric roads in elevated positions, such as the crests of major drainage divides. It is common for the surface of the prehistoric road to be excavated and bermed when approaching an Herradura. (Literally, a "horseshoe.")

HISTORIC REUSE (of roads) - A common situation in which historic vehicular traffic has followed precisely the swale of a prehistoric road.

HOGBACK - A sharp-crested ridge formed by a resistant bed of rock that dips more steeply than 10 degrees.

HOLOCENE - That period of geologic time since the end of the Pleistocene. Synonymous with late Quaternary.

HOUSED KIVA - See blocked-in kiva.

IMAGE - 1) A verb meaning to be visible in aerial photography. 2) A noun, referring to the visual appearance of a feature or class of features in aerial photography.

IMAGED ALIGNMENT OR SWALE - A segment of prehistoric road which has been identified on aerial photography.

IMAGERY - The representation of a surface obtained by photographic or nonphotographic remote sensing. Unless otherwise stated the term as used here refers to aerial photography, from either the vertical or oblique perspective.

INFILTRATION CAPACITY, RATE - Maximum rate at which the soil, under given conditions, can absorb rain or shallow impounded water.

IN SITU PRESERVATION - Preservation of a cultural resource in its original location and in an unaltered state generally achieved through project relocation, redesign, or cancellation.

INTENSIVE SURVEY - A systematic survey of a defined area in which transect intervals do not exceed 30 m and in which all cultural materials are recorded.

INTERFLUVE - That area between adjacent streams flowing in the same general direction.

INTRUSIVE WARE - A pottery type or ware found in small quantities outside of the main area of its distribution or manufacture.

INVENTORY SURVEY - A more or less systematic field examination of a defined parcel of land, with the primary objective of finding and recording archaeological phenomena. Compare to reconnaissance survey.

ISOLATED OCCURRENCES - As used in this project, small numbers of artifacts found in an isolated context, cultural remains representing ephemeral activity (such as a recent barrel dump or hearth), or remains whose information potential could be exhausted through simple recordation. While Isolated Occurrences are not usually significant individually, collectively they can provide important archaeological information. Documentation of the prehistoric roads, for example, is critically dependent on the accurate location and description of isolated ceramic pieces.

JAR - A vessel form recognized archaeologically by sherds with smoothing, slip, or decoration on their convex surface.

JOINT - A fracture in rock, generally more or less vertical, along which no appreciable movement has taken place.

LACUSTRINE - Pertaining to, or produced by, lakes or lake environments and processes.

LAG GRAVELS - Gravels concentrated on the ground surface through erosion of gravel-bearing sediments. In order to produce lag gravels erosive forces must be strong enough to remove the less resilient sediment matrix, yet too weak to transport the gravels.

LEVELING - A type of asymmetrical transverse profile in which material has been removed from and/or added to one side of the roadway to produce a level road surface.

LEVELS OF INVENTORY - Different degrees of intensity of inventory work performed according to varying management needs.

LINEARITY - See lineation.

LINEARITY RECOGNITION - The definition of lineations on aerial photography and/or on the ground.

LINEATION - In photointerpretation, a straight or gently curved linear feature visible on aerial photographs. The term is also sometimes used in reference to linear features visible from a ground perspective. Lineations may result from natural or cultural processes. Synonymous with linearity.

LITHIC SITE - A site consisting almost entirely of stone artifacts. Compare to Ceramic site, Ceramic/Lithic site, and Lithic/Ceramic site.

LITHIC/CERAMIC SITE - A site consisting of mixed lithics and ceramics, but with lithic material predominating. Compare to Ceramic site, Ceramic/Lithic site, and Lithic site.

LITHOLOGY - In common usage, refers to rock type, e.g., sandstone, granite.

LONGITUDINAL DUNE - A general term for various types of linear dune ridges which extend parallel to the direction of the dominant dune-building winds.

LONGITUDINAL PROFILE - A cross-section profile of a road segment measured parallel to the centerline of the road. Contrast to transverse profile.

LOW SUN ANGLE PHOTOGRAPHY - Aerial photography taken within two hours of sunrise or sunset, when the sun is low on the horizon. Photography taken under these conditions enhances visibility of the topographic relief of the land surface.

MAINTENANCE - As utilized in this report, maintenance refers to efforts expended to keep a road in a certain state or condition.

MAPOGRAPH - The brand name for an enlarging/reducing device which projects opaque or transparent originals at a desired scale. By superimposing this projected image on a map, a feature such as a prehistoric road can be transferred from a photograph to a topographic map with acceptable accuracy. Also see stereo zoom transfer scope.

MATERIAL TYPE - As applied to lithics, a category of rock, with distinctive color, texture, phenocrysts, or other characteristics which distinguish it from other categories.

MATURE SOIL - Soil having well developed soil horizons.

MECHANICAL ANALYSIS - An analysis of the particle size distribution of a sediment which involves separating size fractions by mechanical means.

MIDDEN - An accumulation of pottery sherds, hearth sweepings, organic debris, and other trash associated with long-term occupation of an archaeological site. Two specialized forms of midden are recognized:

FORMAL MIDDEN - A sizeable mound created by the deliberate dumping of trash and construction debris in a limited area. Recently many features formerly thought to be formal middens associated with great houses have been interpreted as constructed earthworks, rather than true middens (Nials, Stein and Roney 1983).

SPALL MIDDEN - A mound or scatter of debris resulting from construction of a masonry building.

MILEAGE (of a prehistoric road) - 1) A measurement in miles of the total linear distance along an imaged or projected alignment between two points. 2) A measurement in miles of the linear distance which can actually be recognized on the imagery or on the ground as a prehistoric road.

MIRROR STEREOSCOPE - A stereoscope which uses mirrors to reflect images of aerial photographs into a set of lenses, allowing the entire area of overlap between two stereo photographs to be seen at one time, and allowing stereoscopic magnification of the photograph.

MONOCLINE - A stratum which dips in one direction and which apparently does not form the side of an anticline or syncline.

MONOCULAR MODE - See stereo zoom transfer scope.

MONTMORILLONITE - A group of clay minerals characterized by swelling in water due to introduction of interlayer water.

MOUND RELIEF - The height of a mound.

NATURAL LEVEE - A ridge of alluvium deposited at the margins of some types of streams.

NEGATIVE TOPOGRAPHIC EXPRESSION - A type of transverse profile in which the road surface is at a level below the adjacent terrain or border elements. Contrast to positive topographic expression.

OUTLIER - 1) Any great house located outside the immediate vicinity of Chaco Canyon. 2) Any one of thirty-three Archaeological Protection Sites designated in Public Law 96-550.

PARALLEL ROADS - The occurrence, documented in several widely separated areas, of two prehistoric roads having approximately parallel trends. Distances between parallel roads vary, but they are typically 15 to 30 m apart.

PATH - A narrow avenue of travel from one point to another. Paths are usually produced by wear rather than by deliberate modification of the land surface, except locally. Paths follow contours and are usually only wide enough to accommodate foot travel. Synonymous with trail. Contrast to road.

PEDOGENESIS - Soil formation caused by a variety of processes, i.e., weathering, clay translocation, leeching, etc.

PHOTOGRAMMETRIC MAPPING - The production of a map, usually a topographic map, through the use of aerial photographs and a stereoscopic plotter.

PHOTO-RECOGNITION PATTERN - A series of characteristics observable in aerial photography which imply the presence of particular cultural features on the ground.

PHOTO VISIBILITY - As applied to this study, the degree to which linear features are visible from the aerial perspective, i.e., on aerial photographs.

PIECE PLOTTING - Mapping the individual features and artifacts which are present on a site using relatively precise techniques.

PIT ROOMS - Subterranean rooms recognized first in early Pueblo I times, often associated with surface masonry structures. Pit rooms may have been used as domiciles, as were pit houses in Basketmaker III times, or they may have been kivas or proto-kivas with a more specialized function.

PLATY STRUCTURE - A tendency for natural soil units to break into "plates" having subparallel faces which are normally oriented approximately parallel to the ground surface. Contrast to prismatic structure.

PLATFORM - An elevated, flat-topped masonry structure with rubble fill, usually located on a talus slope or at the base of a cliff or bluff, and thought to have served as a landing for a ladder or stairway. Platform landings are usually 3 to 6 m in size and may be at the head of the ramp.

PLATFORM MOUND - An artificial, elevated structure with masonry or adobe walls enclosing a rubble or refuse fill. Containing walls may be vertical or sloping and may or may not have steps or stairways leading to the top flat surface of the structure. This type of structure was first recognized in the Mesoamerican area where it was used to elevate religious structures above the surrounding terrain. The feature is also known in the Hohokam area where the structures are primarily of a caliche-adobe.

PLAZA - A large open area, often overlying fully subterranean kivas, found in front of a roomblock and enclosed by a single row of contiguous rooms, a masonry wall, or some other less formal delineation.

POUR-OFF STRUCTURE - A masonry feature located at the base of low cliffs to facilitate the channeling of rain run-off into ditches for distribution to agricultural fields. First defined by Gwinn Vivian for the Chaco area, these features were subsequently identified by Vivian as road-related ramps and stairways rather than water control devices.

POSITIVE TOPOGRAPHIC EXPRESSION - A fill longitudinal profile or type of transverse profile in which the roadway is elevated above adjacent terrain. Contrast to negative topographic expression.

PRESERVATION ETHIC - An attitude toward cultural resources which recognizes their nonrenewable character and which encourages the use of nondestructive techniques of data collection.

PRIMARY CHARACTERISTICS - The original characteristics of prehistoric roads, prior to modification by the processes of weathering, erosion, and deposition. The character of the road during utilization. Examples include construction features, artifact scatters, and other associated sites or features. Contrast to secondary characteristics.

PRIMARY REDUCTION - A stage of lithic manufacture during which cortex is removed. Cortex covers 100 percent of the dorsal surface of flakes removed during this stage. Contrast to secondary and tertiary reduction.

PRIMARY ROAD - A prehistoric road measuring approximately 9 m in width. Contrast to spur.

PRISMATIC STRUCTURE - A tendency for natural soil units to break into prism-shaped pieces with faces which are normally oriented approximately perpendicular to the ground surface. Contrast to platy structure.

PRODUCTION SITE - A site or community potentially capable of producing a surplus of agricultural products. Production sites are associated with productive agricultural soils, ample water, and relatively long growing seasons. They are frequently the loci of Basketmaker III communities and modern settlements. Contrast to transportation site.

PROFILE - A graphic representation of the ground surface between two points. In reference to roads, there are two types of profiles, longitudinal and transverse.

PROJECTED ALIGNMENT OR ROADWAY - A segment of prehistoric road which is not ground or photo visible, but which is interpolated between two or more visible road segments, road-associated features or sites.

PROXIMITY - See Simple Physical Proximity.

PUBLIC ARCHITECTURE OR STRUCTURE - Constructions which functioned beyond the needs of individual households. Examples include great kivas and great houses.

QUATERNARY - The younger of the two geologic periods in the Cenozoic era. Encompassing approximately the last two million years, the Quaternary is normally divided into the Pleistocene and Holocene epochs.

RAMP - A type of fill profile in which material is piled against a cliff or bluff, creating an inclined plane which facilitates access to the top.

RECONNAISSANCE SURVEY - A search for archaeological sites or roadways which does not include systematic coverage or intensive documentation of a defined area. Compare to intensive inventory.

RECORDING FORMAT - A format for recording what are considered to be the most basic, essential parameters of variability in road characteristics and road-associated sites and features.

RECORDS SEARCH - Systematic accumulation of relevant background data.

REFUSE MOUND - See midden.

RESIDENTIAL PATTERNING - The pattern of distribution of domiciliary structures and their related features within a larger, loosely structured prehistoric community. During Chacoan times the residential pattern was characterized by small domiciles, grouped into loosely structured, dispersed communities in proximity to productive soils.

RESOURCE ROAD - A road which provides access not to another site or community, but rather to some natural resource such as a stone quarry, bedrock tank, or timbered area.

RILL - A small channel, ususally V-shaped, produced by overland flow of water.

ROAD (PREHISTORIC) - Tangible, physical evidence of a route of travel or transportation serving as a means for communication between prehistoric sites or areas of activity, with these characteristics: 1) a relatively uniform width; 2) alignment of linear segments; 3) more than casual construction; 4) normally, failure to deviate in course for minor topographic obstacles. Compare to path and trail.

ROAD-ASSOCIATED - See road-related.

ROAD COMPONENTS - Aspects of a prehistoric road, including 1) the road surface, 2) features which relate to the construction of the road or which facilitated the use of the road (e.g., stairs, hand-and-toe holds), and 3) sites or features associated with the road.

ROAD DELINEATOR - Features which indicated the course of a prehistoric road when it was in use. Example include berms, grooves, cairns, and road markers.

ROAD ELEMENTS - Physical characteristics of the roadway, including the longitudinal profile, transverse profile, border elements, and the road surface.

ROAD MARKERS - Isolated slabs found at wide intervals along prehistoric roads in contexts which indicate that they were culturally introduced. These objects may have functioned as road delineators.

ROAD-RELATED - An adjective applied to any site or feature whose function, characteristics, or location were substantially conditioned by or altered because of the presence of a prehistoric road.

ROAD SEGMENT - Any ground- or photo-visible portion of a roadway.

ROAD-SITE RELATIONSHIP - A functional association or spatial association of Direct Association or Simple Physical Proximity between an archaeological site and a prehistoric road.

ROAD SURFACE - That portion of the road between the margins. The road surface may be of either primary or secondary origin, and is either depressed, elevated, or possesses no relief at all. Synonymous with roadway.

ROAD SYSTEM - A road which connects three or more outliers.

ROADWAY - See road surface.

ROCK COUNT - A technique for detecting construction along prehistoric roads which consists of counting and monitoring various attributes of stones on the ground surface, sampled per unit area along a transect perpendicular to the projected alignment. Synonymous with stone count.

RORSCHACH APPROACH - A technique of searching for roads on the ground, which involves free association by an observer considering subtle or imaginary information such as swales, erosional features, vegetation differential, and topography. This approach often leads to confusion and must be supplemented by more objective procedures.

ROUND ROADSIDE ATTRACTION - Round features found along prehistoric roads. Two types were recognized: 1) mega variety, which was called the Herradura during this study; 2) minor variety, which consists of small slab concentrations one or two meters in diameter possibly representing collapsed cairns or slab boxes.

ROUTE - The observed or presumed overall course of a road or road system, often including areas where direct evidence of the road is sparse or lacking.

RUBBLE - Non-articulated rock spalls, bedrock debris or masonry elements, 1) resulting from excavation of a roadway, 2) resulting from the collapse of a structure, 3) used as artificial fill in construction of a structure.

RUBBLE MOUND - The mound of masonry elements resulting from collapse of a structure.

SAND - Sediment particles between 1/16 mm and 2 mm in diameter.

SCANNING TRACK - A track and roller device upon which a mirror stereoscope can be mounted. The device allows the photointerpreter to move the stereoscope easily, viewing different parts of a stereopair without disturbing the position of the photographs.

SECONDARY CHARACTERISTICS - As applied to this study, the characteristics of roads after modification by the processes of erosion, deposition, and weathering. Compare to primary characteristics.

SECONDARY PROCESSES - As applied to this study, those processes of erosion, deposition, and weathering which serve to modify the primary characteristics of roads.

SECONDARY REDUCTION - A stage of lithic manufacture which involves final removal of cortex. Flakes produced at this stage have multiple flake scars, as well as some cortex on their dorsal surface. Compare to primary and tertiary reduction.

SECOND-ORDER PHOTOCLASSIFICATION - Detailed photointerpretative efforts, normally involving the use of lower-altitude aerial photographs or higher magnification stereoscopic viewing of aerial photographs than used in first- order (reconnaissance) photointerpretation. As applied to this study this normally involves the distinction between various types and ages of cultural lineations, in preparation for ground checking. Contrast to first-order photoclassification.

SEGMENT - See road segment.

SHALE - A sedimentary rock composed of consolidated or partially consolidated clay-sized (diameter less than 1/256 mm) particles.

SHALLOW - As applied to transverse profiles of prehistoric roads, shallow refers to roads having negative topographic expression of less than 35 cm.

SHEETWASH - See slopewash.

SIGNALLING STATIONS - Features, including Windes' Shrines, tower kivas, and El Faro at Pierre's Site among others, which may have been used in a visual communication system, presumably involving the use of fire.

SILL - A tabular igneous body which has been intruded parallel to the bedding or schistosity of the surrounding rocks.

SIMPLE PHYSICAL PROXIMITY - This term applies to sites, features, or artifacts which are within a corridor survey area, but are not in Direct Association or Consistent Topographic Position with respect to the prehistoric road.

SITE - A location characterized by physical evidence of either intense or sustained past human behavior. As used in this report, this term is generally limited to areas in which intra-site patterning of artifacts or features might yield useful information. Contrast to Isolated Occurrences.

SLAB BOX - A feature consisting of upright slabs arranged to form a square or rectangle approximately 1 m across. Ethnographically these features are used as repositories for prayer sticks.

SLOPEWASH - The movement of soil and rock material down a slope caused predominantly by gravity, assisted by running water that is not concentrated into channels. Synonymous with sheetwash.

SMALL HOUSE - A series of one to five contiguous rooms, usually constructed of simple coursed masonry and arranged in a linear, "L" or "U" shape. Mound relief is usually less than .75 m. Small houses are often, though not always, assumed to be domiciles. Compare to field house, and domicile.

SOIL - A genetic body of materials at or near the surface of the earth which has natural horizons that have developed over a period of time, and which is normally capable of supporting plant growth. Soil is a product of past and present environments and is developed to varying degrees, depending upon environmental parameters and the amount of time it has been subjected to these parameters.

SOIL FORMATION - See pedogenesis.

SOIL STRUCTURE - The tendency for soil aggregates to part along certain lines, producing relatively uniform sizes and shapes of soil peds (natural soil units).

SOLUM - The material lying above parent material, in which the natural processes of soil formation take place.

SPOT CHECK - A method of reconnaissance which consists of simply looking on the ground at a particular identifiable point or restricted area along an imaged alignment, rather than walking a longer segment or performing more intensive inventory.

SPUR - 1) A branch stemming from the main course of a road, leading to a site or feature which is not on the main course. 2) A narrow road, usually less than 5 m in width. Contrast to primary road.

STABLE UNCONSOLIDATED SEDIMENTS - As utilized in this study, the term is applied to sediments, usually in relatively flat areas, in which there has not been significant removal from, or addition to the land surface in the past several thousand years. The term is used somewhat synonymously with soil, and these sediments are usually characterized by mature soil.

STAIRWAY - A series of deliberately constructed steps which facilitate passage over cliffs and ledges. Stairways may consist of hand-and-toe holds, steps or artificial ledges carved in bedrock, or masonry constructions.

STEREOSCOPE - A devise for viewing stereographic aerial photographs in three dimensions.

STEREO ZOOM TRANSFER SCOPE - An optical instrument used to transfer information from an aerial photograph to a base map. The base map is viewed at a fixed scale, and the photo is enlarged or reduced (zoomed) until its scale matches the map scale. The two views are seen optically in superimposition, rather than by projection of one onto the other (see mapograph). The stereo zoom transfer scope, as opposed to the zoom transfer scope, permits the operator to view a pair of photographs in the stereoscopic mode under magnification. To transfer information to the base map, the machine is switched to monocular mode, which superimposes the right-hand photo and the base map.

STONE CIRCLE - An oval to circular feature 7 to 20 m in diameter, built on slickrock, with construction ranging from alignment of upright slabs to massive compound masonry walls 1 m high.

STONE COUNT - See rock count.

STRAND LINE - That portion of a former or present shoreline between high and low water. A beach.

SUBSTRATE - As applied to this study, that portion of the earth lying within a few meters of the surface. This material may be either unconsolidated sediments or bedrock.

SWALE - A low place in a tract of land, often subtle and difficult to percieve in flat light.

TERTIARY REDUCTION - A stage of reduction which results in the production of flakes with no cortex on the dorsal surface. Compare to primary and secondary reduction.

TEXTURE - In sediments, the size distribution of sedimentary particles in a deposit. In rocks, the size, shape, and arrangement of particles in the rock.

TOWER KIVA - A series of three or four circular chambers about 5 m in diameter, stacked one above the other within a common rectangular housing or tower. Contrast to elevated kiva.

TRAIL - 1) See path. 2) Particularly in early archaeological literature this term sometimes refers to any route of travel, including formally constructed roads, which were made by Indians and not designed for use by wheeled vehicles.

TRANSPORTATIONAL MIDSLOPE - That portion of the landscape, normally having a steep angle (26 degrees to 35 degrees), which is characterized by transport of materials by mass wasting and very rapid overland flow. Compare to alluvial toeslope, colluvial footslope, convex creep slope, and fall face.

TRANSPORTATION SITE - A site not strongly associated with agricultural production, but rather which is associated with a prehistoric road and which is in an area of low local site density. Transportation sites are those which are believed to have been built solely to service or facilitate use of prehistoric roads. Contrast to production site.

TRANSECT - The linear area actually inspected visually by an archaeological surveyor in the course of an inventory.

TRANSVERSE DUNE - A stongly asymmetrical dune ridge extending transverse to the direction of dominant sand-moving winds. Compare to longitudinal dune.

TRANSVERSE PROFILE - A cross-section profile of a road segment, measured perpendicular to the centerline of the road. Compare to longitudinal profile.

UTILITY WARE - Plain, undecorated or corrugated pottery.

UTILIZATION SURFACE - The primary roadbed.

VEGETATION DIFFERENTIAL - An often subtle difference of vegetative species, composition, density, or vigor between the area enclosed by road margins and the area outside of road margins.

VERIFICATION (of a prehistoric road) - Establishing through careful observation and documentation that observed linearities represent prehistoric roads.

VISUAL SIGNATURE - See photo-recognition pattern.

WALL (bordering a prehistoric road) - An adobe, adobe-stone, masonry or cobble feature which: 1) has a primary height in excess of 25 cm if constructed of adobe or adobe-stone, 2) has a primary height of three or more courses of stone if constructed of masonry or cobbles; 3) has a width in excess of 50 cm; 4) if masonry, is compound or core-and-veneer; 5) may or may not be parallel to the axis of the road. Compare to curb.

WIDTH (of a prehistoric road) - Where definable border elements or stone concentrations are present, width is defined as the distance between inside edges of border elements. If no recognizeable border elements are present, width is defined as a representative distance between the break in slope on either side of the roadbed depression.

WINDES' SHRINE - A low "L," "J," arc, or comet-shaped masonry enclosure exhibiting massive compound or rubble-core construction and located on a topographic high point which maximizes visibility, especially line of sight to great houses.

ZAMBULLIDA - A low masonry enclosure up to 1.5 m in primary height, rectangular to circular in shape, 3.5 to 9.0 m in interior diameter, and exhibiting massive compound or core-and-veneer masonry. Zambullidas represent a class of structure which is less than complex than the great house due to the conspicuous lack of housed kivas, but which is more architecturally complex than Herraduras. (Literally, a "duck.")

APPENDIX A

APPENDIX A

DISCOVERY AND DESCRIPTION: CHACOAN ROAD FIELD STUDIES 1963-1980

VIVIAN FIELD STUDIES

Gordon Vivian

The excavation in 1951 of Kin Kletso, a late Chacoan town, rekindled Gordon Vivian's interest in the large classic sites in Chaco Canyon. He was particularly interested in exploring Kluckhohn's (1939:157) theory that Chacoan towns and villages were contemporaneous, and he believed that an explanation for their apparent cultural differences might lie in different adaptations to the Canyon environment. Publication of Bryan's volume on the geology of Chaco Canyon in 1954 (Bryan 1954:45) provided conclusive evidence for deeply buried irrigation canals in the vicinity of Pueblo Bonito, evidence corroborated by Judd (1964:228-229).

Between 1963 and 1964 Gordon Vivian carried out sporadic research in Chaco Canyon aimed at more precisely identifying, locating and testing features he believed to be water-control related (canals, gridded gardens, reservoirs and dams). Prior to this period of research Vivian had collected data on water control features, and features he thought were related to water control, from several sources. An initial impetus for the study had come in the early 1950s when Vivian and Leland Abel constructed a large aerial mosaic of Chaco Canyon and its immediate environs from Soil Conservation Service (SCS) aerial photographs taken in the mid-1930s. These photographs, enlarged from a scale of 1:32,000, showed a number of linear features within and outside the Canyon that Vivian identified as canals. A gridded field area near Chetro Ketl was also quite visible, while similar gridded fields near Casa Rinconada were more difficult to define.

During the late 1950s Vivian collected data from Holsinger, Judd and others on water control systems in the Chaco area, studied aerial photographs of Chaco Canyon taken by Charles Lindberg in 1929 and also carried out a modest attempt to further aerial photographic coverage of some Canyon features. This consisted of outlining the edges of several canals near Penasco Blanco with lime and having the features obliquely photographed by Robert Lister from a small aircraft in 1949. (An attempt by R. Gwinn Vivian and C. Randall Morrison to photograph some of these same canals in 1971 by using a camera mounted on a small rocket gave less satisfactory results.)

It has been apparent for some time that Gordon Vivian's study of water control systems in the Chaco included investigation of some features that were later identified as roads or road-related features. Until recently it was not clear whether he had differentiated between the two classes of features, though he was aware of earlier references to roads. Fortunately, Randall Morrison, archaeologist at Chaco Culture National Historic Park, recently located a memorandum dated November 20, 1964, from Gordon Vivian to the Chaco Superintendent regarding Vivian's work on the "Prehistoric Water Conservation Project" which makes it clear that Vivian was aware that some features he was studying were probably roads.

In June 1964, Vivian contracted with Limbaugh Aerial Mapping in Albuquerque (later a division of Bovay Engineering) to provide aerial photographs at a scale of 1:3000 of five locations in Chaco Canyon and four locations outside the limits of the Canyon. Canyon locales included an area from Pueblo Bonito to approximately one-quarter mile east of Chetro Ketl (aerial photograph designation, Chettro Kettle), the Casa Rinconada area west to the South Gap (Pueblo Bonito), the mesa south of Pueblo Alto to the cliff edge above Chetro Ketl and Pueblo Bonito (Old Alto), the southwestern portion of the head of Weritos Rincon in South Mesa (Casa Rinconada), and the north side of the Canyon at the western limits of Chaco Canyon from the Escavada Wash to Gwinn Vivian's (1974:104) Rincon 4 North (Penasco Blanco). Locales outside the Canyon were: Pueblo Pintado west to Chaco Canyon but not including the head of the Canyon (Khinthyel), the Kin Bineola Wash from the vicinity of Kin Bineola to the large dam on this wash south of the Lake Valley Chapter House (Khinbiniyol), the general vicinity of Kin Ya'a (Khinya), and a swath from the Escavada Wash north of Chaco Canyon to the site now known as Kin Indian Ruin (Kinebeto Wash). Vivian placed white cross-and-strip panels on the features for aerial identification and later photointerpretation. Rocks used to hold the panels in place were located in several places during the 1981 BLM reconnaissance of some of these features. (See summary of Chaco Center Remote Sensing Project work in 1973 for further discussion of panel "alignment of stones.")

After study of the aerials, Vivian spent three weeks in Chaco Canyon in October and November 1964 continuing his work. Specifically, "the purpose of my work at Chaco on this past trip was to take data for cross section drawings of the structures, take detail photographs and check out on the ground any portions not sufficiently distinct in the photographs" (Vivian 1964). Although many of the features that Vivian investigated were water control and not road-related, a complete accounting of his study follows to avoid future uncertainty about his research and his recording of Chacoan roads. Because his field notes were not lengthy, this information is given in tabular form. Table A-1 summarizes all available information on the Gordon Vivian water conservation and road

TABLE A-1

GORDON VIVIAN 1964 FIELD WORK

System/Feature Name Gordon Vivian, 1964	Limbaugh Name 1964 Aerials	Other Aerial Coverage	Vivian's Field Work October/November, 1964	Vivian's Comments, 1964
Pueblo Pintado (Road)	Khinthyel	1930s SCS	Reconnaissance and mapping. One test trench across road in vicinity of Pintado.[a/][b/] (Field notes, maps and drawings.)	"Portions of canal traced 1.8 miles, one cross section taken."
Gallo Wash (Water control feature)	No photos	1930s SCS	Cross sections of several exposed canals in Gallo Wash. (Field notes, maps and drawings.)	"Several sections taken of exposures in this canal which runs from the Gallo Wash to Una Vida."
Chaco-Vicente Confluence (Water control feature)	No photos	1930s SCS	Canal exposure faced?[c/]	"One exposure of lined canal slope 9 ft. wide approx. half the canal. (There should be others in this general vicinity.)"
Kin Nahasbas (West) (Water control feature)	No photos	1930s SCS	Cross sections of several exposed canals in side canyon wash. (Maps and drawings.)	"Traced and took cross sections of two parallel canals diverting runoff back upstream."
Weritos Rincon (Water control feature)	Casa Rinconada	1930s SCS	Reconnaissance: Mapped two masonry dams. (Field notes, maps and drawings.)	"Plan and sections of two masonry dams."
Chetro Ketl Waffle Gardens (Water control feature)	Chettro Kettle	1930s SCS Lindbergh	Reconnaissance only	"They were not discernible on the ground. (They are apparently visible from the cliffs after periods of wet weather.)"
Terrace Above Pueblo Bonito	Old Alto	1930s SCS	Reconnaissance only.[d/] (Field notes, maps and drawings.)	"I did not succeed in measuring this because of snow. A few hours will do it when the weather improves."[d/]
Pueblo Alto	Old Alto	1930s SCS	Reconnaissance and mapping. Traced and cut through several portions of wall.	"Sections made of walls on mesa, canal cut through low mesa, and high retaining walls probably related to agricultural terraces...."[e/]
Rinconada Waffle Gardens (Water control feature)	Pueblo Bonito	1930s SCS Lindbergh	Reconnaissance only.	"Sections of these may be discernible on the ground. Comparison of present-day aerial photographs with one made by Lindbergh about 1929 and others made in or about 1927, suggest that parts of these may be examined on the ground. It was snowing heavily by the time I got to them and results are so far inconclusive."

TABLE A-1 (Concluded)

System/Feature Name Gordon Vivian, 1964	Limbaugh Name 1964 Aerials	Other Aerial Coverage	Vivian's Field Work October/November, 1964	Vivian's Comments, 1964
Penasco Blanco	Penasco Blanco	1930s SCS	Reconnaissance and mapping. Excavated canal in several locations, exposed head gate, did plan views and cross sections.	"Cross sections made of exposed canal, wall covered by soil traced, and several sections made of buried retaining wall and gate or sluice."
Mesa west of the Escavada/Chaco Confluence	No photos	1930s SCS	Reconnaissance. Border along road cleared, cross section drawing.	"Sections exposed of 37-foot-wide causeway (?) traceable for approximately 1.6 miles. This is not a canal."
Escavada Wash	Kinebeto Wash	1930s SCS	Reconnaissance and measurements on feature width and gradient.	"Cross sections and gradient of canal from lower end to catchment area."
"The Gap"	No photos	1930s SCS	Reconnaissance only.	"Although aerial photographs show some sort of canal, 'road' or 'ceremonial pathway' here, we were not able to locate on the ground any lined ditch, retaining wall, or other construction. (Incidentally, if that is a canal coming in through the south gap, it is not in the same relative position to the terrain as are the other instances examined.)"
Kin Klizhin	No photos		Reconnaissance. Dam mapped and section drawn.	"Measurements and sections of rock wasteway and dam. Portion of ditch located downstream from dam and recorded."
Kin Bineola	Khinbiniyol		Three trenches across canal; canal exposure in wash faced for section.	"Buried retaining wall of canal cut by arroyo cleared; three cross sections of canal taken."
Kin Ya'a	Khinya		None.	"I did not reach this site because of bad weather and snow."

Notes: a/ The location of this test is not known.

b/ The map of this canal system was based on the SCS aerials.

c/ The exact location of this work is not known.

d/ This terrace should not be confused with the terracing to the east of Pueblo Alto and referenced as "agricultural terracing" under Old Alto field work. Some terracing similar to the Pueblo Alto terraces seems to have been present south of Pueblo Alto and north of Pueblo Bonito at approximately the same elevation and within the same topographic situation as the Pueblo Alto terraces. Much of this terracing system appears to have been destroyed in about 1939 by Civilian Conservation Corps work on a road that was built from Cly Canyon to just north of Pueblo Bonito just below the second cliff level on the north side of Chaco Canyon.

e/ Earlier work on these walls and "canal" had been carried out in the late 1940s or early 1950s by Gordon Vivian and Al Lancaster. The features at that time were thought to be water conservation related. The high retaining walls or terraces were reported by the anonymous chronicler of Judd's work in Chaco Canyon (Anonymous 1928).

study. Entries have been ordered so that those within or at the ends of Chaco Canyon are listed first (from east to west) followed by systems or features located outside the Canyon.

Of the 16 locations that Vivian studied or planned to study, six had evidence for roads. It is clear from his notes that he recognized one feature on the mesa west of the Escavada/Chaco confluence as not being a canal, though his identification as a "causeway" was guarded. Another feature, "The Gap" cut (referenced by Judd in his Bonito volumes), was not positively identified as a water control structure. Roads at Pueblo Pintado, Pueblo Alto and on the north side of the Escavada Wash (the Chaco North Road) were all identified by Vivian as canals. Presumably he would have classified the road at Kin Ya'a as a canal. No additional field work was done on this project; some maps and cross sections were drafted in final form but no report was written.

R. Gwinn Vivian

1967 Field Studies

Gordon Vivian's unfinished prehistoric Chacoan water conservation project was taken up by R. Gwinn Vivian in two phases of field work. The first, a two month preliminary study funded by the University of Arizona, was conducted in the summer of 1967. The second, a year-long project based on the 1967 work and funded by the National Science Foundation, was undertaken in 1970-1971. Both studies involved the investigation of Chacoan roads and road-related features, but it was not until midway through the 1970-1971 work that some of these features were positively identified as roads. In brief, Gwinn Vivian's work in 1967 was concentrated on the 16 locations selected for study by Gordon Vivian with special emphasis on the Pueblo Alto area. However, some other work was carried out in Clys Canyon and other locations not investigated by Gordon Vivian. The 1970-1971 work done by Gwinn Vivian and Robert Buettner involved not only a more thorough study of the 16 locations but a complete Canyon survey from Wijiji to Penasco Blanco. Most of the features studied in 1970-1971 and some investigated in 1967 were related to water conservation, and they are not discussed here. The remaining results of these two seasons of work are described in more detail below. Table A-2 lists features in the Pueblo Alto area thought to be water-control related in 1967 and reported by Vivian (Vivian 1970), and correlates them with roads or road-related features reported by Vivian and Buettner (1971). The 1967 data are from Figure 3 in Vivian (1970).

Several features at Pueblo Alto were tested in 1967. Three trenches approximately a meter in width were placed across Canal 3 (later identified as road B on Vivian and Buettner's Pueblo Alto Road System, Figure A-2 in this report) at the point where the road leaves a possible plaza area east of Pueblo Alto near the refuse mound. These trenches all revealed a "canal," later recognized as a road, approximately 8 m in width sloping up on both the east and west

TABLE A-2

PUEBLO ALTO ROAD FEATURES - 1967 AND 1970-71 CORRELATION

1967 Designation	1970-71 Designation	Function
Collecting Wall (CW) 1	None	Boundary Wall (?)
Collecting Wall (CW) 2	None	Boundary Wall (?)
Collecting Wall (CW) 3	None	Boundary Wall (?)
Canal (C) 1	None	Unknown
Canal (C) 2	A-1	Road
Canal (C) 3	B	Road
Canal (C) 4	F, Chetro Ketl Rim Road	Road
Reservoir (R) 1	None	Unknown
Reservoir (R) 2	None	Plaza
Pour-off Structure 1	A-1-1	Masonry steps & walls
Pour-off Structure 2	B-3	Ramp/masonry steps (?)
Pour-off Structure 3	B-5, Bc 87	Ramp
Pour-off Structure 4	F-3, Bc 86[a/]	Ramp
Farming Terrace (FT)	None	Farming terrace
Gridded Gardens (G)	None	Gridded gardens

[a/] Lloyd Pierson's site card for Bc 86 indicates that two "rooms" were excavated in this "11 room Talus house by the SAR about 1934."

sides but with a more pronounced bank on the west. This bank on the west was topped with a core-and-veneer wall approximately one m high and 60 cm in width. The bottom and banks were well-packed "adobe," and a slight dip was noted in the very bottom of the road in all three trenches.

Work was also carried out in Reservoir 2, the "plaza" area bordering Pueblo Alto on the east. Several test pits were placed in the center of this enclosed area to determine the nature of the fill, and walls bordering the area were defined by exposing the top masonry course. The feature on the northern bordering wall, later described by Loose (1974) as a "blockhouse," was defined at this time. The gate in this wall, discovered by Gumerman and Ware in 1972, was only tentatively identified in this work. Some of Gordon Vivian's tests along the road bordering the wall south of the refuse mound were cleared again to obtain wall measurements. Tests were also made in the segment B road (see Figure A-2). A trench was placed across the road after segment C branched from B (but before B dropped over the cliff edge at features B-2 and B-3. Features B-2 (a ramp) and B-3 (a possible masonry stairway) were tested also, and the results of this work are reviewed in more detail in the discussion of the 1970-1971 North Division study.

Probably the most significant work done in 1967 relating to roads was the facing of ramp B-5, identified in 1967 as pour-off structure 3 and reported by Lloyd Pierson (1949) as Bc 87, a 15-room talus unit. This feature is a part of the Chetro Ketl to Pueblo Alto Road (road B in the Pueblo Alto system) and was constructed to provide access from the cliff top to the canyon bottom. The ramp is located near the head of the rincon that lies behind and to the north of Chetro Ketl, and is on what appears to be a steep talus of sand sloped up against the west wall of the rincon (see Figure A-1). Wall outlines were faintly visible on the surface prior to testing, presumably the basis for Pierson's room identification. The top of the mound is approximately 10 m below the top of the cliff edge.

The northern end of the talus had been eroded by water pouring over the cliff edge and this disturbed portion was faced to provide a cross section of ramp construction. The walls visible on the surface were defined, and a short trench was placed across the southern (lower) end of the ramp. These tests provided information on ramp construction. Apparently, the site of a partial sand talus against the the cliff was selected to help reduce the height of the ramp and the quantity of fill material in the ramp. Construction consisted of building two parallel walls on this talus to contain fill between the walls and between the cliff face and the innermost wall. The distance between the two walls averaged 2.2 m; distance between the innermost wall and the cliff face ranged from 2.3 m to more than 7 m. The wall remnants averaged 7 m long and 60 cm wide. The walls extended north for an undetermined additional length (estimated to be at least 2 m), but the southern ends were faced. The walls were finished (veneered) only on the cliff-facing side, the opposite side consisting of protruding rough stone. Both walls were footed on a 45 cm thick foundation of large, roughly-shaped stones. The foundation and the "floor" surface between the walls was covered with a layer of gray clay. Fill between the cliff and innermost wall and between the two walls was primarily sand, with small rubble rock in the top levels. Wall height at the north end was approximately 1.2 m and 45 cm at the south end. There was no good evidence that the walls were considerably higher in the past, though some wall fall could have been buried by the talus sand. It was fairly obvious that the ramp had not reached the cliff top. Rather, this structure probably led to a landing which served as a base for a log ladder. This same system of access was probably employed at the ramp at Bc 86 and at feature C-4, the platform structure in the Chetro Ketl talus unit cited by Ferdon (1955:6-7, Figure 2) as an "integrated platform mound."

1970-1971 Field Studies

The 1970-1971 field work carried out by Gwinn Vivian and Robert Buettner was primarily oriented toward water control investigation. When additional work on the Pueblo Alto "water control system" led to the discovery that many of the water conservation features were road-related (Figure A-2), the decision was made to devote some project time to an examination of roads. A major reason for this decision was the realization that a number of Chacoan features classified as water conservation devices were probably road-related and that criteria for differentiating between features such as canals and roads must therefore be established. Because the primary focus of research was on water conservation, only limited time was scheduled for road investigation; however, survey was planned and Robert Buettner was given primary responsibility for recording road features. He spent about two man-months on this work locating, recording, and doing limited testing of roads and associated features, with Gwinn Vivian and Jon Haas assisting during part of this period. A summary of these investigations was given in a report to the National Science Foundation, "Prehistoric Water Conservation in Chaco Canyon" (Vivian 1972). This information also formed the basis for a paper by Vivian and Buettner, "Pre-Columbian Roadways in the Chaco Canyon Region, New Mexico," given at the 1973 Annual Meeting of the Society for American Archaeology (Vivian and Buettner 1973). A more detailed synthesis of road investigations made by Buettner and Vivian follows. An inventory of the work completed and data collected by Vivian and Buettner is on file at the Arizona State Museum and the BLM Albuquerque District Office (Vivian and

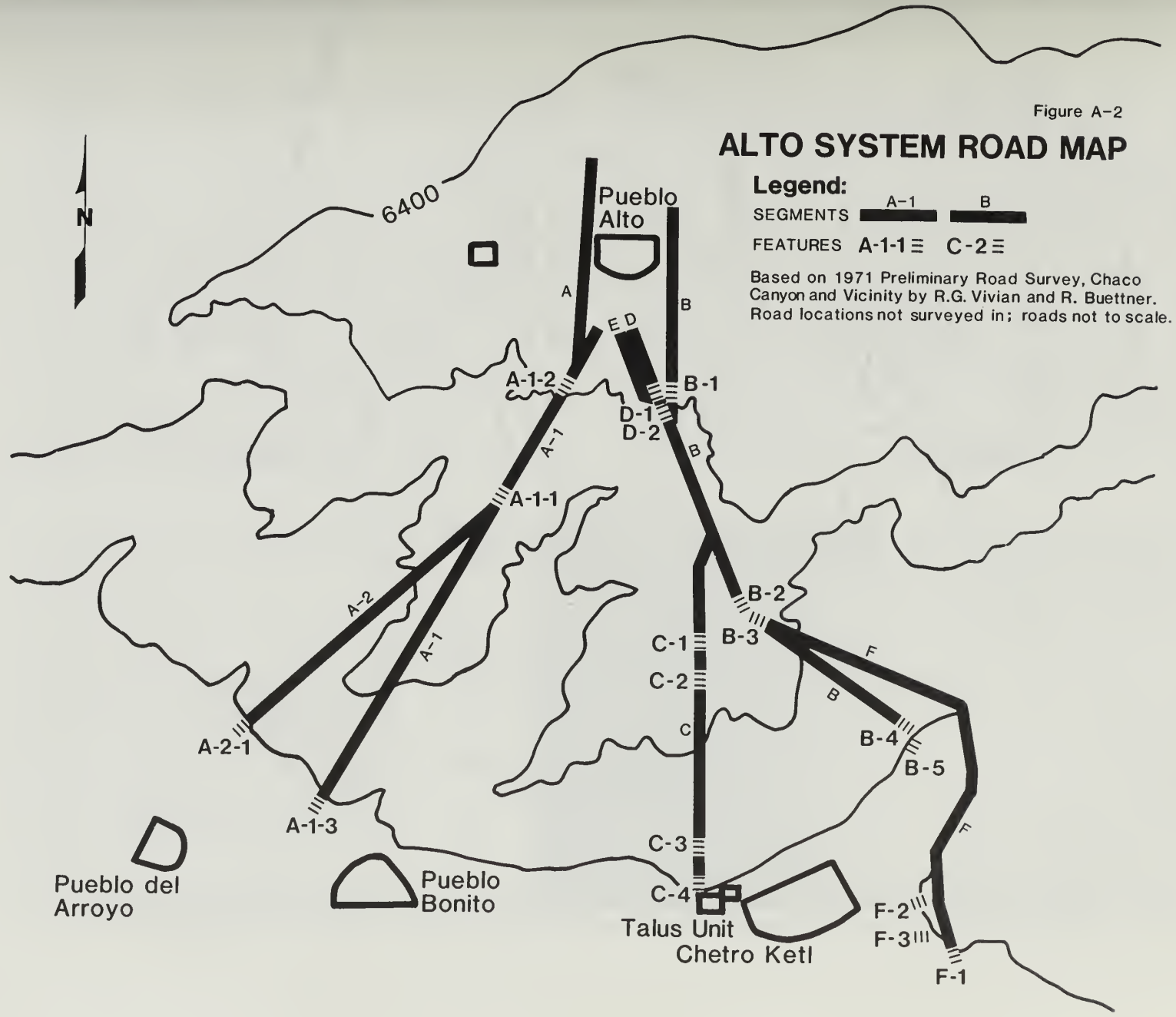
Figure A-1. Features located on road segment from Pueblo Alto to the base of the rim of Chaco Canyon, northeast of Chetro Ketl, recorded by Vivian and Buettner during their 1970-1971 field work. A-Feature B-4, a set of rock-cut steps; B-Feature B-5, a ramp originally recorded by Vivian in 1967 and later designated as Bc 87 by the UNM Chaco survey.

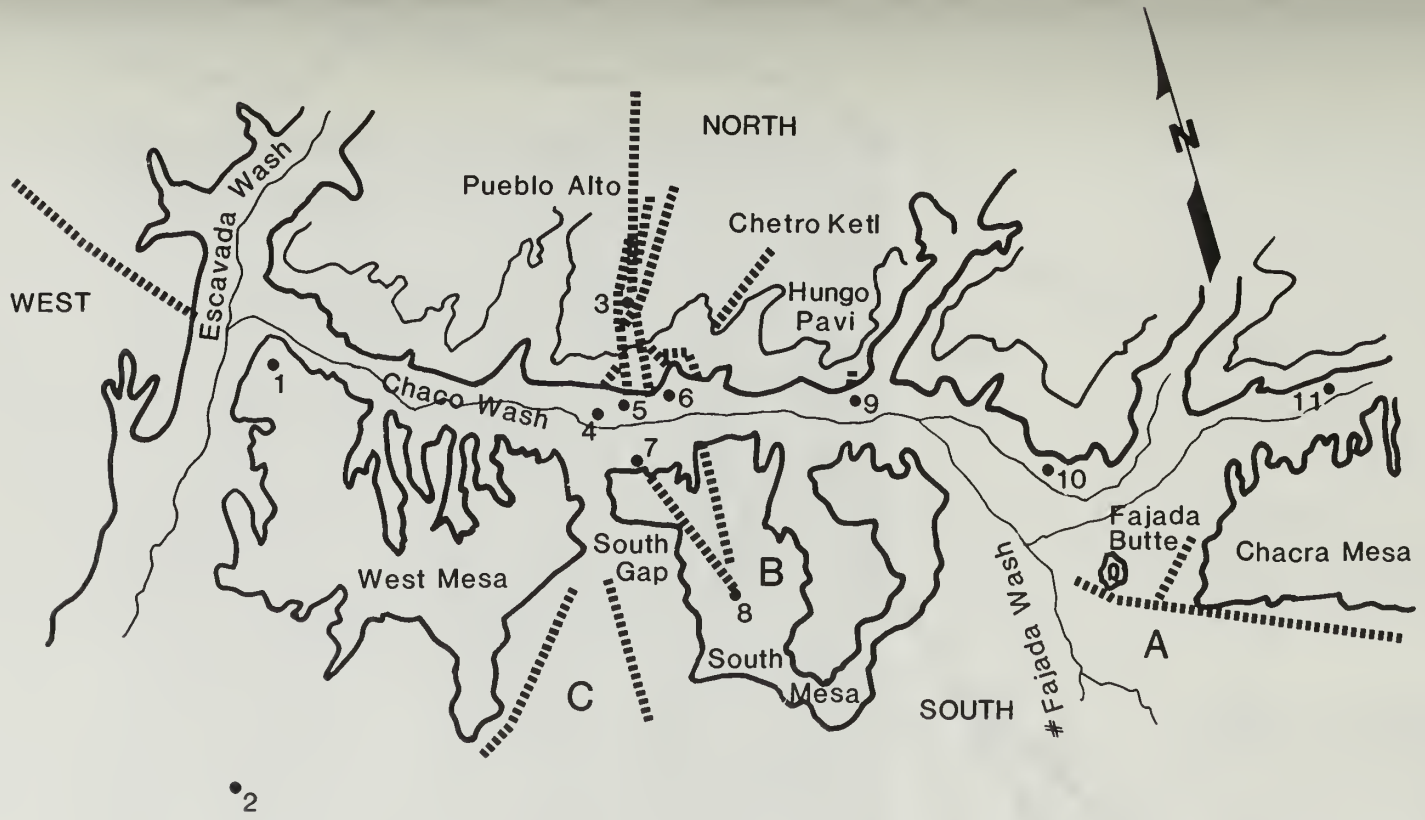
Buettner 1971).

After determining that the Pueblo Alto water control system was a road system, other identified water control features were resurveyed, especially those with long sections of canal. It was found that the Pueblo Pintado, Kin Ya'a, Escavada Wash and Chaco/Vicente confluence canals were roadways--canals located at other sites were determined to be water conservation devices. (Note: Current topographic maps show Vicente Wash as Fajada Wash). The 1930s SCS aerial photographs of the Canyon and surrounding areas were re-examined and on the basis of road morphology as expressed on this imagery, similar "lines" were identified for field investigation. It was soon discovered, partially on the basis of the Pueblo Alto experience, that rock-cut masonry stairways were common attributes of these roads and that they could be used as a guide to the presence and orientation of roads when the roadbed was faint or obliterated. It was assumed that Chaco Canyon was the center of a road "network" and that roads radiated from the Canyon. Based on this assumption, and using aerial photographs, the network was divided into four divisions: North, South, East and West with Chaco Canyon at the center (see Figure A-3). Each division consisted of one or more roadways with various components. The North Division was the most complex consisting of several roads coming into the Canyon through Pueblo Alto. Four roads were tentatively identified entering the Canyon from the south, but only one roadway was identified in the Eastern and Western Divisions. In addition, several roads in the areas outside the Canyon were checked. These

Figure A-2

ALTO SYSTEM ROAD MAP





MAJOR BONITO PHASE SITES

1. PENASCO BLANCO
2. KIN KLIZHIN
3. PUEBLO ALTO
4. PUEBLO DEL ARROYO
5. PUEBLO BONITO
6. CHETRO KETL
7. CASA RINCONADA
8. TSIN KLETSIN
9. HUNGO PAVI
10. UNA VIDA
11. WIJIJI

#Formerly Vicente Wash

Figure A-3

Vivian and Buettner Road Divisions for Chaco Canyon
Road Divisions and Division Segments as plotted by Vivian and Buettner with relationship to major Bonito Phase sites. The East Division Road (Pueblo Pintado to Chaco Canyon) is not shown.

segments were located some distance from the Canyon but were presumed to be a part of the network, although they could not be definitely tied to it. Information on the four divisions, isolated stairways, a bridge and outlying roads follows.

East Division. Only one road was located entering the Canyon from the east. This was identified as the East, or Pueblo Pintado Road (not shown on Figure A-3). Approximately the eastern half of this roadway was Gordon Vivian's Pueblo Pintado canal which he believed carried water captured near Pueblo Pintado to a low field area east of the site about halfway to the head of Chaco Canyon. Data on this road were derived from aerial photographs, ground checks, and a test trench placed across a well-defined portion of the road near Pueblo Pintado. End points on the road established in 1970-1971 were Pueblo Pintado on the east and the head of Chaco Canyon on the west. The road extended northwest (20 degrees north of west) from the southwest corner of Pueblo Pintado for a distance of 4.5 km following an almost direct route to the head of the Canyon. A narrow set of rock-cut steps (averaging 70 cm wide) in the cliff edge marked the entry into the Canyon. Though no evidence for the road could be found in the Canyon bottom, one of Judd's Navajo informants did report that a road "led from Pueblo Pintado to Pueblo Bonito and on to Penasco Blanco" (Judd 1954:346). Loew's (1875) reference to a road from Pueblo Pintado to Abiquiu suggests an extension to the east, though there is little other evidence for such an extension.

Where visible on the ground, the road appeared as a shallow depression, rather flat-bottomed and bordered by low earthen ridges. Measurements taken from the crests of bordering ridges indicated an average width of 12.5 m. No masonry bordering walls were noted, although some stone rubble was present in the ridges. The test trench showed an actual road width of 8.5 m with bordering ridges sloping gently up to the crest. The road had been prepared by cutting down approximately 10 cm to a native white sandy clay layer and mounding this excavated material along the edges of the cleared strip. The ridges rose an average of 15 cm above the roadbed. In several locations the road was cut through low natural rises in the terrain creating linear depressions in ridges and low hills. Several small sites or "villages" were noted along the roadway; the greatest concentration occurred about 3.5 km northwest of Pueblo Pintado where seven sites with five to 15 rooms were located.

West Division. One road was identified extending west from Chaco Canyon. This West Road was located initially by Gordon Vivian on aerial photographs. As previously noted, he recognized that this feature was not water-conservation related and tentatively identified it as a "causeway." All visible features were field recorded in 1970-1971 and a test trench was placed across a section of the road near the Canyon. This road followed a fairly direct route 40 degrees west of north from the top of the cliff at the end of Chaco Canyon (where the Escavada Wash joins the Chaco Wash) to the edge of a small tributary of Ahshislepah Canyon, a total distance of about four km. This road was more easily distinguished on the ground than the East Road and was marked in many places by bordering ridges. A number of "cuts" through hills and ridges were noted (Figure A-4). No masonry walls were located, but rock rubble was common in the borders. Like the East Road, the depression was shallow and flat-bottomed. The test trench showed a bedrock base with a width of 9.5 m and bordering ridges rising about 25 cm above the roadbed. The bedrock had been altered slightly to provide a flat roadbed.

Figure A-4. Field inspection of Vivian and Buettner's West Division Road, taken in the spring of 1971. Left to right: Jeff Dean, John Corbett, Emil Haury, Robert Buettner.

Descent into Chaco Canyon was accomplished by a series of seven rock-cut and masonry stairways constructed on the cliff face (Figure A-5). These stairways became increasingly less elaborate in construction near the base of the cliff, but this may have been the result of greater erosional action. No stairway was found entering the tributary of Ahshislepah Canyon, nor could evidence for the road be found beyond (west) of Ahshislepah. (Though Vivian and Buettner noted a burned rock area at the base of the cliff in Ahshislepah Canyon, they did not recognize this as a ramp into the Canyon on the West Road because they had presumed that the point of entry on this road was down-Canyon or south of the ramp.) Three small sites were located where the road paralleled the tributary canyon (only one was reported as a "feature" of this road system), and one was considered at the time as a

Figure A-5. Stairway complex on the Penasco Blanco to Ahshislepah Road, near Penasco Blanco Ruin. Chaco Wash is visible in the background.

possible "way station."

South Division. Three roads were located entering Chaco Canyon from the south. All were found on aerial photographs and checked by ground survey, but field recording was only done for the Rinconada Road (also referred to as the Tsin Kletzin Road and the Chetro Ketl-Tsin Kletzin Road). Summary descriptions of the three routes follow.

The Vicente Wash Road (or South A, a briefly used reference term) entered the Canyon at the Fajada Butte break in the Chacra Mesa opposite the town of Una Vida. This road, as discerned on aerial photographs, began east of Fajada Butte on the south flanks of the Chacra Mesa and appeared as a series of cuts in the talus ridges (this road has since been referred to by Obenauf as the Chacra Face Road). No sign of the road was present in the intervening drainages. It was traced for about 3.2 km along the talus of the Chacra Mesa to a point just east of Fajada Butte where it divided. One branch entered the Canyon between Fajada Butte and Chacra Mesa following the western face of the Chacra in this mesa gap area for about 2.1 km. It was presumed that the end point of this segment was the town site of Wijiji, though no aerial imagery or ground check proof of this supposition was derived. The other branch passed to the south of Fajada Butte near the base, and was then lost in the drainage area of the Vicente Wash. Generally, its direction seemed to be toward Una Vida. This second branch could be traced on the aerial imagery for about 1.2 km. The only surface evidence for the entire system was cuts through low hills. Slumping of the cuts precluded collection of accurate measurements. Many small village sites were noted in the vicinity of Fajada Butte; both branches of the road passed near a number of these villages. Gordon Vivian's Chaco/Vicente confluence "canal" could not be relocated in 1970-1971, and it was not possible to determine if the canal feature he located was a portion of the Vicente Wash Road.

The second southern roadway, the Rinconada Road (also known as South B, Tsin Kletzin Road, Chetro Ketl-Tsin Kletzin Road) was also divided into two branches. The first branch (referred to by Vivian and Buettner as Rinconada-Tsin Kletzin) was easily distinguished on the 1930s SCS aerial photography. The imagery showed that this branch began at the northwest corner of the town of Tsin Kletzin and crossed South Mesa dropping over several short cliffs in the process. The route of this road appeared to be direct, running 10 degrees west of north, with alignment on the isolated great kiva, Casa Rinconada, and on the southwest corner of Pueblo Bonito across the Canyon from Casa Rinconada. Though three sets of rock-cut steps were found on the projected route of the road on the cliff above and to the south of Rinconada, some diversion from this route would have been necessary at the point where the road reached an abrupt cliff edge in a small side rincon further south. Despite an intensive search for signs of this road on the mesa, no good evidence was located. Much of the mesa top is covered by shifting sand dunes, but even in less-sandy areas no ridges or walls were noted. The rock-cut steps, noted above, were the only tangible ground evidence noted in 1970-1971.

The second branch of this road (subsequently proposed as the Chetro Ketl-Tsin Kletzin Road) was more easily defined on the ground, but there was almost no indication of its presence on the SCS aerial imagery. This road was thought to begin on the north-facing cliff of South Mesa opposite and slightly east of Chetro Ketl where four well-preserved sets of rock-cut steps ranging from 1.5 to 3 m in width led up the north cliff face to the mesa top. A rubble mound near the top of the talus slope but below the rock-cut steps was judged to be the remains of a masonry stairway leading to the base of the cliff. Some limited evidence for the road was present at the cliff top. This short section paralleled the edge of a side canyon to the Chaco passing through a natural break in a sandstone outcrop on the mesa top. Beyond this break, the road was bordered for about 40 m by large unshaped sandstone blocks resting on the bedrock. This portion of the road was illustrated by Judd (1964, Plate 40, upper photo). Width of the road in this section varied from 7 to 8.2 m. Additional evidence for this second branch including ramps, rock-cut steps and bordering walls, was collected in 1974 by Vivian and W. James Judge; these same features were located by the Chaco Center Remote Sensing Project in 1973. Connection of the two branches could not be established by ground check or on aerial photographs, but it was presumed that they both ended at Tsin Kletzin.

A third south road entered Chaco Canyon through South Gap, the break in Chacra Mesa opposite the town of Pueblo del Arroyo. This was known as the South Gap Road (also South C) and at times was also referred to as the South Gap to Kin Klizhin Road. Like other South Division roads, this one was best known from the SCS aerial imagery. The northern terminus was approximately one-half km south of the National Monument boundary fence at a point where the "Gap" widened. Evidence for the road in the more narrow portions of the Gap was considered to have been removed by the effects of heavy drainage into the canyon. The road paralleled the southern side of West Mesa to the southeastern point of the mesa where it curved around the end of West Mesa. Evidence for the road beyond this point was not found, but the outlying town of Kin Klizhin is visible from this location. The total length traced was about 1.5 km. Like the Vicente Wash Road, the only surface indications were several cuts through low hills; however, the complete road line could be seen during a brief aircraft reconnaissance done in 1971. Three village sites were noted at various points along this

roadway. A branch of the South Gap Road was tentatively identified in 1970-1971 solely on the basis of aerial imagery. This branch began near the known "southern terminus" of the South Gap Road and extended in a southeasterly direction on a line that was thought could lead to the outlying town site of Kin Ya'a. No signs of this feature could be detected on the ground.

North Division. The North Division of roads was the most complex defined during the 1970-1971 research. The aerial mosaic compiled by Gordon Vivian and Leland Abel from SCS imagery showed numerous lines that might be interpreted as roads on the north side of Chaco Canyon in the lower 15 km of canyon. Only a limited number of these linearities were checked by survey in 1970-1971. Three separate road systems were distinguished, the Pueblo Alto, Chetro Ketl and Hungo Pavi.

The Pueblo Alto system was divided into seven identifiable segments: A-1, A-2, B, C, D, E, and F (see Figure A-2). These all lay between Pueblo Alto and the rim of Chaco Canyon to the south of Alto. Using the SCS aerial imagery it was also possible to plot at least three, and possibly seven, roads radiating north from Pueblo Alto, but no intensive field work was done on these segments. One segment, the Chaco North Road or the Great North Road (as later referenced by Morrison) could be traced for approximately 5.6 km, making it one of the longest known roads in the Chacoan network in 1970-1971. Of the roads that could be defined on the SCS imagery north of Pueblo Alto, all but one converged at a single point on a boundary wall extending east from the pueblo. (Prescott College located a "gate" in this area in 1972.) One other road passed to the west of Pueblo Alto (and presumably through a similar gate in the west boundary wall) having split from one of the radiating roads about 1.2 km north of Pueblo Alto. This same road was thought to lead into segments A-1 and A-2, although it could not be positively determined that it was the source of both. The gate on the east side of Pueblo Alto was considered to be the source of segments B, C and F. Segments D and E were short, and may have originated at the front arc of rooms on the south side of Pueblo Alto joining segment B slightly to the southeast of the town (see Figure A-2). A more detailed description of the Pueblo Alto segments follows.

Segment A-1 began southwest of Pueblo Alto and the orientation at this location suggested an origin near the front-center of Pueblo Alto; this was not the same orientation as the road bordering the pueblo on the west noted above. Segment A-1 extended in a southwesterly direction toward the rim of Chaco Canyon to a point about .5 km from Pueblo Alto where a spur road to Pueblo del Arroyo, segment A-2, diverged. Segment A-1 was tested in two locations between Pueblo Alto and feature A-1-1, a set of masonry steps which was also tested. The tests indicated that the road in this section was bordered for all or most of its length by low masonry walls averaging 80 cm wide and 30 cm high. Road width ranged from 6.3 m to 6.6 m measured from the inside edges of the masonry bordering walls. The roadbed had been cleared to bedrock in both areas tested.

This section of segment A-1 included two locations where the traversing of a rock ledge and a low cliff was required. Features at these locations included fairly well-preserved rock-cut steps (feature A-1-2) at the ledge and a masonry stairway (feature A-1-1) at the cliff. The rock-cut steps (a total of 14) averaged 15 cm high and 50 cm deep. Edges of the steps were present and their width was 6.47 m. Feature A-1-1, the masonry stairway, when excavated consisted of twelve steps, although it was estimated that at least six more had been present when the road was in use. The remnant stairway was five m wide, but based on the location of a bordering wall on the east, full stairway width would have been six meters expanding to almost eight meters at the base of the stairway (a rock outcrop prohibited the builders from maintaining a consistent eight meter width). The steps averaged 15 cm (or generally one stone) high and 35 cm in tread. The stairway bordering wall (averaging 85 cm in width) could be traced at least 12 m south of the masonry steps.

Another wall in the vicinity of feature A-1-1 was only briefly investigated, and while its association with road segment A-1 seemed obvious, its function could not be determined. This wall branched from the east stairway bordering wall at a point about five m south of the base of the masonry steps. It extended in a slight arc about 14.5 m northeast to a point where it abutted the cliff edge thereby forming an enclosure between the wall, the cliff edge and the east stairway wall. The degree of curvature of the wall was approximately the same as the curving cliff edge suggesting that the wall may have been primarily aesthetic in plan, serving as a broad stairway balustrade or parapet at the cliff base. Only the top of wall was defined and wall height was not determined. Wall width was approximately one m.

Segment A-1 south of feature A-1-1 could be defined on aerial photography and was distinctly visible from aircraft, but surface indications were so vague that no width measurements were obtained. Only scant evidence for bordering edges on this section was noted. Feature A-1-3, the well known rock-cut stairway located in the Canyon wall west of Pueblo Bonito (the "Bonito Staircase"), was at the southern terminus of road A-1. A rubble mound at the base of the rock-cut steps was tentatively identified as another set of masonry steps, but no tests were made in this feature.

Road segment A-2 branched west from A-1 in a southerly direction several meters south of feature A-1-1; the precise point of branching was not determined. This segment was first noted on a flight over the area and later ground checking showed that the only visible surface features were a number of short portions of masonry bordering wall in an area 100 to 300 m southwest of feature A-1-1. This bordering wall was tested in six locations. In all instances the bordering wall was present only on the west side of the road. The east side was only vaguely defined and no precise measurement of road width could be obtained although it was estimated at 4 m or slightly wider. Wall width averaged 80 cm; height varied from 8 cm to 50 cm.

The only numbered feature (feature A-2-1) on segment A-2 was a cliff-edge stairway opposite Pueblo del Arroyo. Road segment A-2 terminated at a crevice in the cliff face in which several building stones were tentatively identified as the remains of masonry steps. Below this crevice, yet near the top of the cliff talus, was a masonry and rubble stone mound that had previously been interpreted as a habitation unit of the "talus house" or "talus unit" type. Its location suggests that it may be a road-related feature.

Segment B, which was also known as the Pueblo Alto to Chetro Ketl Road, was traced from the east side of Pueblo Alto to Bc 87, a ramp at the cliff base in the rincon northeast of Chetro Ketl. Two other segments, C and F, branched from B while segments D and E appeared to intersect B a short distance southeast of Pueblo Alto (see Figure A-2). Five features were recorded on segment B and tests were made in four locations.

Segment B was first tested in 1967 (see previous discussion of Gwinn Vivian's 1967 field work). The core-and-veneer west bordering wall (feature B-1) located near the Pueblo Alto refuse mound could be traced on the surface to the first cliff edge over 200 m south of the town. This wall had been cleared in several places by Gordon Vivian and Al Lancaster in the 1950s and two additional tests were made by Vivian and Buettner. The wall was from 81 to 95 cm wide, faced on both sides, 25 to 45 cm high, and footed on sterile sand or sandy clay. No tests were made in the eastern bank or curb as there was no surface indication of a wall, and it was assumed that this border was small rubble, probably cleared from the roadbed. The road in this section was about 8.5 m wide, measured from the inside edge of the west wall curb to the inside base of the east rubble bank.

The portion of segment B lying between features B-1 and B-2 did not have precisely defined borders. Segment B descended the first low cliff edge (a gradual drop of 8 to 10 meters) by means of a set of 8 to 10 rock-cut steps (feature B-1). They were badly worn and width was estimated at six to seven m. Several large unshaped sandstone blocks bordered the steps on the east. At the base of this low cliff, the road area was characterized by the remnants of a masonry bordering wall on the west and a shallow (10 cm), "U"-shaped (8 cm wide) groove cut into the exposed bedrock 4.5 to 6 m east of the wall remnants. The groove and fallen wall border could be traced for about 105 m south-east of the first cliff base to a point where segment C could be defined as a separate spur road. (See segment C discussion for further consideration of this groove.)

No evidence for an east border to segment B could be found in the "groove zone," but distinct road edges were present and tested in an area where segment B cut through a low rise in the topography beyond the groove but before the road dropped over the cliff edge at feature B-2. Road width in this location was 8.85 m measured from the inside edges of bordering walls. These walls were two stones high (ca. 15 cm) and from 60 cm to 90 cm wide. The roadbed had been cleared to bedrock and was slightly concave, dropping a maximum of 45 cm in the center measured from the edges of the road at the bordering walls.

Features B-2 and B-3 were located several meters southeast of the above-described test area at the second cliff edge. They were respectively rock-cut steps and a ramp or ramp-stairway. Two sets of rock-cut steps were recorded at feature B-2; both provided access down the cliff edge and may have been contemporaneous. These steps were located at the mesa edge where a wide crevice in the sandstone, created by block jointing, provided a means for descending the cliff. The first set (a) consisted of at least 13 steps cut into the almost-perpendicular side of the crevice. (Erosion of the soft sandstone continues to obliterate evidence of this road-related feature; 13 steps are now fairly distinct and there are vague traces of two additional steps. Holsinger [1901:68], however, recorded 21 steps at this location in 1901.) The stairs arced slightly to conform to the shape of the cliff wall and were 8 to 9 m in in length (original length most likely was 9 m for all the steps). The steps were highly eroded and height and tread varied considerably. The second set (b) began on the opposite side of the crevice and consisted of five steps cut into both sides of a crack in the sandstone forming a "U"-shaped set of steps. Maximum length was 2 m, with each step averaging 10 cm high and 25 cm deep. These steps provided access to the same location in the crevice as did set (a). Rubble in the bottom of the crevice suggested that masonry steps may also have been constructed in the narrow passage.

The crevice opened onto, and was at a right angle to, a rubble mound that fronted the crevice and paralleled the sandstone block that formed one side of the crevice. This mound, feature B-3, was briefly tested in 1967 and was considered at that time to be a pour-off structure (PO 2); it was recognized as a ramp or ramp-stairway in 1970-1971. Tests revealed a roughly constructed retain-

ing wall that paralleled the sandstone block and extended at least 24 m from the cliff edge down a slight talus slope. Rock fall near the lower or basal portion of the structure was assumed to postdate use of the ramp and the retaining wall may have extended an additional three m. The space between the wall and the sandstone block ranged from 7.6 to 9.7 m and was filled with sandstone rubble (large boulders to spalls) and soil. The retaining wall ranged in height from 30 cm at the bottom (east) of the ramp to 1.5 m near the top. Though the structure was thought to be a water control feature when tested, surface clearing did not give any evidence of steps. It seems probable, therefore, that this structure was only ramped and not stepped. On the other hand, the absence of veneer on the retaining wall would not be expected in Chacoan construction and shaped blocks used for veneer and steps may have been removed for use elsewhere.

The exact route of segment B from feature B-3 to feature B-4, at the Canyon rim northeast of Chetro Ketl, could not be determined during ground check or on aerial imagery, though a small remnant of masonry on a rock ledge about 75 m southeast of feature B-3 and on line between B-3 and B-4 was assumed to be road-related. Most of this zone is stabilized dunes and the bordering edges of the road may be deeply buried. Feature B-4, a set of rock-cut steps, is located at the lip of the cliff above the rincon behind Chetro Ketl. These steps are above and slightly north of feature B-5, the ramp originally designated as Bc 87 by the UNM Chaco Survey (Figure A-1). As noted in the earlier discussion of testing at Bc 87, the northern portion of this structure had been washed away at some time in the past. Six steps are visible at feature B-4. They are 9 m long, 65 cm deep and 20 cm high. The south edge of these steps is fairly distinct.

Feature B-5, the ramp below feature B-4, has been discussed in the previous section describing the 1967 field work. The route from feature B-5 to Chetro Ketl (presuming that this road did go to Chetro Ketl) was not evident, and no testing was done in the rincon to locate road features.

Segment C, referred to by Vivian and Buettner as the Pueblo Alto to Talus Unit Road, was a spur road that branched from segment B almost due north of the Talus Unit No. 1, a small site located near the northwest corner of Chetro Ketl. As noted in the discussion of segment B, the intersection or splitting of segments B and C and the beginning (or ending) of the bedrock groove seemed to coincide. Segment C was not mapped, but the general route when plotted on aerial photographs and the USGS quadrangle for the area showed the road dog-legging after leaving segment B before moving in a rather direct line to the cliff edge above the talus unit. (Road orientation at the point of leaving segment B is 25 degrees west of north. The road continues on this course for about 25 m before changing to 5 degrees east of north.)

Four features were recorded on segment C; tests were made only in feature C-1.

The route of segment C was over less-steep scarps then segment B, and much of the roadway was bordered. Curbing was usually a low masonry wall but in several locations bedrock ledges of sandstone had been employed as a border. No tests were made on bordered sections of the road, but some measurements were taken. Road width was fairly consistent at about 4.5 m. Masonry walls bordering the road averaged a meter in width and in a few locations where the wall rested on or near bedrock wall height was 25 to 35 cm. As with other bordering walls, construction was of shaped stones with one to three courses present. The roadbed in most places was probably bedrock.

Features recorded on segment C were rock-cut steps, masonry stairs, combinations of these construction elements, and a postulated platform-and-log-ladder construction at feature C-4 in the talus unit. Feature C-1 was a rock-cut and masonry step stairway built in a sandstone crevice that led to a short flight of at least seven masonry steps. The masonry steps were bordered on the west by a wall that continued beyond the steps. Features C-2 and C-3 were both rock-cut steps cut in low sandstone ledges along the road route. Masonry steps were probably also present at C-2 and remnants of low bordering walls were recorded at both locations.

Feature C-4 was identified by Vivian and Buettner as including Room 1934-3 of the talus unit and a series of "hand-and-toe holds" and two notches cut into the cliff face behind this room (the talus unit is built against the cliff face). Room 1934-3 was interpreted by Ferdon (1955:6-7) as an "integrated platform mound," an interpretation questioned by Gordon Vivian (1959:83). Vivian and Buettner believed that the room was a platform, but not a platform mound functionally similar to those cited by Ferdon in Mexico. The room or platform was a walled enclosure approximately 9.15 m by 6.1 m near the middle of the roomblock. The excavator reported:

"A feature of the room is the lower partition which roughly bisects its length. The central portion of the wall has a series of three steps, rising toward the north, each 8 feet, 1 inch long and approximately 2 feet wide. A raised platform at each end of the lower two steps, slightly above the level of the central one, seems to have supported two vigas running lengthwise along the partition wall. The holes in which their ends were buried were visible in the masonry above the two platforms, with fragments of decayed wood still in them. The platforms were plastered over the top and had carefully squared corners" (Woods 1934:16-17).

Ferdon did not mention the two vigas, and interpreted the platforms at the ends of the steps as stairway balustrades. He believed that the area to the north of the stairway

partition had been filled and capped to serve as a platform. The area to the south of the stairway partition was thought to have been a walled court. Gordon Vivian (1959:83) argued that the presence of the two vigas resting horizontally on the step balustrades effectively "covered the steps and in effect obscured their form and nullified their use." Ferdon noted that the structure had been stabilized and Vivian (1959:83) pointed out that "any stabilizing activities at this site which Ferdon refers, were, I am sure, under the direction of the excavators." The point that Ferdon was probably trying to make was that excavators who thought they were excavating a room might have stabilized the structure as a "room," thereby obliterating some evidence for use as a platform. Combined with other structural evidence on the cliff face it seems fairly certain that Room 1934-3 was used as a platform.

The cliff face behind Room 1934-3 is marked by a series (15 were visible in 1970-1971) of hand-and-toe holds some five to six m above the present surface of the ruin mound. In addition, two notches were cut in the sandstone on the cliff face on either side of the lowermost hand-and-toe holds. These notches are about 1 m in length and the space between them on the cliff face is estimated to be 4 to 5 m. A crevice in the cliff face above the hand-and-toe holds would have provided access to the cliff top. Because access was impossible, it could not be established whether rock-cut steps were present in the zone of the hand-and-toe holds, but there was some faint evidence for this. If rock-cut steps were present, the hand-and-toe holds may have been used as climbing aids as in the rock-cut steps behind Hungo Pavi. Vivian and Buettner interpreted feature C-4 as a masonry platform base for a log ladder that extended up the cliff face to a narrow "balcony" or landing composed of wood planks set in the two notches. Access above the landing was probably by rock-cut steps, though additional evidence is necessary to confirm this interpretation.

Segments D and E in the Pueblo Alto system were represented by short (less than 50 m) bordered, parallel roadways that began on the south side of Pueblo Alto and proceeding southeasterly appeared to intersect segment B below the first cliff edge near the "groove." Two features (D-1, D-2) were recorded on segment D; feature D-2 was partially tested.

The most conspicuous evidence for these segments was at the first cliff edge where masonry walls of rather large stones bordered the outer edges of the roads; a wall common to both segments served to separate them. Width of segment D at this point was about 10.5 m; segment E was approximately 9 m in width. The bordering walls averaged 90 cm wide and 65 cm high. Features D-1 and D-2 consisted of rock-cut and masonry steps at two locations on the sloping cliff edge. Six rock-cut steps and one or two masonry steps were present at D-1, while 14 rock-cut steps and an undetermined number of masonry steps had been built at D-2. Most of the rock-cut steps were badly eroded and in both locations additional steps were thought to have been present originally. Where measurable, the rock-cut steps were about 10 cm high and 35 cm deep.

Erosion of the sandstone on the route of segment E precluded obtaining any good evidence for rock-cut steps, though they were likely present when the road was in use. Masonry steps were not located on the segment.

Segment F was referred to in 1970-1971 by Vivian and Buettner as the Chetro Ketl Rim Road and later by Vivian as the Pueblo Alto to Tsin Kletzin Road. A portion of this segment was also identified by Gwinn Vivian in 1967 as Canal 4. It was thought to originate at the base of the second cliff edge in the vicinity of feature B-3 on the segment B road and terminate at the cliff edge above Chaco Canyon east of Chetro Ketl. The roadway was most definable where it followed the east edge of the Chetro Ketl rincon on the cliff top and was marked by a bordering wall on the west. This wall was wider (up to 180 cm) and more roughly constructed than bordering walls in the vicinity of Pueblo Alto. Very large stones--up to a meter long--were common, and wall facing was lacking in most sections observed. An observation made by Holsinger suggests that wall remnants along the cliff edge may have served an additional purpose. Holsinger (1901:67-68) in commenting on "an ancient road-way, which can be traced from Chettro Kettle stairway to Alto ruins" reported that it "was 20 feet wide and walled up to a grade with loose rock and filled with soil." Most of the roadway in this area is on bedrock which slopes slightly to the rim of the rincon. The wall may have not only demarcated the edge of the road on the west but retained fill to create a level roadbed. This type of construction has been observed on the Chetro Ketl to Tsin Kletzin branch of the South B Road. There may not have been a bordering wall on the east. At one point low cliffs protrude near the rim of the rincon and the distance between these cliffs and the west bordering edge varied from 7.5 to 9 m, a distance falling within the width range of primary roads. Evidence for the road from near the head of the rincon west to its intersection with segment B near feature B-3 was limited to the remnants of several large blocks serving as masonry steps west of the rincon. (These blocks were not observed and recorded in 1970-1971, but were noted some years later.) This portion of the roadway passes through the same stabilized dune area referred to in the discussion of segment B.

Three features, points of ascent and descent, were recorded on segment F. All were located on the east side and near the mouth of the Chetro Ketl rincon. Feature F-1 was presumed to be the descent point for segment F into Chaco Canyon. This interpretation was based

on the assumption that the road continued across Chaco Canyon and ascended the cliff face on the Chetro Ketl to Tsin Kletzin branch of the South B Road, the locations of these two points on the cliff edges being essentially opposite one another. Constructional evidence at feature F-1 was minimal. This way down the cliff has been used extensively in the recent period, and modern modifications to make the climb easier (low piles of dry-laid rough masonry) may have obliterated prehistoric construction. No rock-cut or masonry steps could be defined with certainty. A low rubble mound on the talus slope near the base of the cliff and in line with the present trail down the cliff was tentatively identified as a ramp or stairway-ramp but was not tested or recorded. Superficially, it resembles a similar mound on the talus across the canyon where the Chetro Ketl to Tsin Kletzin branch of the South B Road begins.

Feature F-2, a rock-cut and masonry step stairway, was constructed mostly in a crevice in the cliff face east of Chetro Ketl. The crevice, which slopes gently downward from the mesa top for about 16 m, contains a set of masonry steps extending the full width of the crevice (about one meter). The crevice opens out several meters above the top of the talus slope and four steps were cut into the cliff face below the base of the crevice. The maximum length of the rock-cut steps was 140 cm, and each step averaged 30 cm high and 30 cm deep. The bottommost step, which is almost 4 m above the ground surface, was at an angle to the three steps above and was grooved its full length (groove width averaged 10 cm, depth 10 cm). The shape of the groove was suggestive of a small log and it was conjectured by Vivian and Buettner that the lower four meters of stairway may have been a log ladder with the top rung resting in the groove. The rock-cut steps were also characterized by several short "rungs" carved into the sandstone near the steps, presumably to assist in using the steps.

Feature F-3, a ramp, was recorded by the University of New Mexico Chaco Survey as Bc 86. Lloyd Pierson's site card on file at UNM notes that two "rooms" were excavated in this "11 room Talus house by the SAR (?) about 1934." It is located east of Chetro Ketl at a point in the canyon wall where the rincon inlet begins. In many respects this ramp resembled the one at feature B-3 (more so than the ramp at feature B-5 or Bc 87). Like B-3, one side of the ramp was formed by the cliff wall, and the masonry on the retaining side was not well faced. The core of the structure was rubble filled as revealed in a test pit near the top of the ramp (presumably the area of the two "rooms" excavated by the SAR in 1934). Ramp width was approximately 7.5 m, and length from cliff face to the canyon bottom was in excess of 10 m. The height of the retaining wall on the south side was not determined through testing but it was thought to be at least a meter in height near the cliff wall. It appeared that the ramp had been partially built on a natural talus against the cliff. The top of the ramp lay at least 8 m below the rim of the cliff and access to the cliff top was presumed, again, to have been by log ladder. Modification of the cliff face, such as at the talus unit, was not observed.

Segment F was interpreted by Vivian and Buettner in 1970-1971 as an alternative to the Pueblo Alto to Chetro Ketl route. They surmised that the ramp at feature B-5 (Bc 87) may have been so severely damaged by flooding in the rincon that the roadway to Chetro Ketl from Pueblo Alto was altered beginning at feature B-3 to follow the course of segment F. The potential alignment of segment F with the Chetro Ketl to Tsin Kletzin branch was not recognized at the time, nor was the possibility of roads crossing Chaco Canyon considered, though there is no reason that this should not happen.

Subsequent review of field data suggested, however, that segments B and F were separate roads with different termini. Three Alto system roads, segments B, D, and E, were thought to originate at or near Pueblo Alto from whence they were routed south to southeast; three segments, B, C, and F, terminated at the Canyon rim. It appears likely that these five segments actually represent three separate roadways beginning at Pueblo Alto and terminating at the talus unit, Chetro Ketl and possibly Tsin Kletzin. In this reconstruction, segment B would begin on the east side of Pueblo Alto but continue as segment F (Pueblo Alto to Tsin Kletzin Road) below feature B-3. Segment D would begin in front of Pueblo Alto, parallel B for some distance and then branch to features B-4 and B-5 below B-3 (Pueblo Alto to Chetro Ketl Road). Segment C would begin as segment E paralleling D and then paralleling D and B before diverting to become the Pueblo Alto to talus unit Road. The wall separating segments D and E and the groove in segment B argue strongly for the visible division of at least the latter two roads (Alto to Chetro Ketl and Alto to the talus unit) at a point in their routes where the topography required their close proximity. If origin points and termini are separate in these cases, then segments A-1 and A-2 may also have separate beginning points; A-1 may begin near the front of Pueblo Alto and A-2 to the west of Pueblo Alto.

The Chetro Ketl system of the North Division was not field recorded. Study was limited to identifying the roadway on the 1930s SCS aerial imagery and walking a portion of it. Morrison (1973) referenced this road as the "Sandspit Road." The road runs diagonally (NE to SW) through Section 7, T. 21 N., R. 10 W., originating in the broken mesa country that drains into the Escavada Wash (Section 5). Subsequent investigation of the Poco Site (29 SJ 1010) suggested that the route of this road may have passed near this site. Nearing Chaco Canyon, the road follows near the

highest portion of the mesa behind and to the east of Jackson's Stairway (see below) and descends the cliff near the point of this mesa. The cliff edge was not investigated for stairways, but two sets of large block masonry steps were located at a point where the road may have intersected segment F of the Alto system. In fact, it is probable that one of the segment F stairways (features F-1, F-2, F-3) (Figure A-6) into Chaco Canyon was a part of this Chetro Ketl Road.

The Hungo Pavi system was postulated on the basis of several rock-cut stairways near this town site. These included the well-known steps in the cliff face behind Hungo Pavi. Maximum width of the steps was 4 m; their average height was 40 cm, tread 20 cm. Two additional sets of rock-cut steps were found at low sandstone ledges on the mesa top above Hungo Pavi. One had five steps, the other four. Width was narrow, averaging 130 cm; height ranged from 8 to 20 cm, depth from 22 to 50 cm. No evidence for a roadway on the mesa top was located in 1970-1971, though features thought to be roads in this area were subsequently identified by the Chaco Center.

Isolated Rock-Cut Steps. Several rock-cut stairways in Chaco Canyon were located or relocated based on prior reports. Though they had no apparent association with roads, they were assumed to be components of the Chacoan road network. The best known is Jackson's Stairway located at the head of the large canyon behind Chetro Ketl (Figure A-7). Association with the Chetro Ketl road system described above is possible. Two sets of steps are present, one complete, the other a partial set that never extended to the canyon floor. The complete stairway consists of 24 steps that average 130 cm in width, 30 cm high and 25 cm deep.

A group of eleven sets of steps in Clys Canyon, a major tributary of Chaco Canyon on the north, may have been known to Judd. These steps range in width from 70 cm to 4.5 m. A similar series consisting of three sets (a total of 30 steps) is known to extend from Rincon 4 North to the northeast of Penasco Blanco and on the north side of Chaco Canyon.

Bridge. A feature excavated during investigation of the Rinconada water control system in 1970-1971 was identified as the

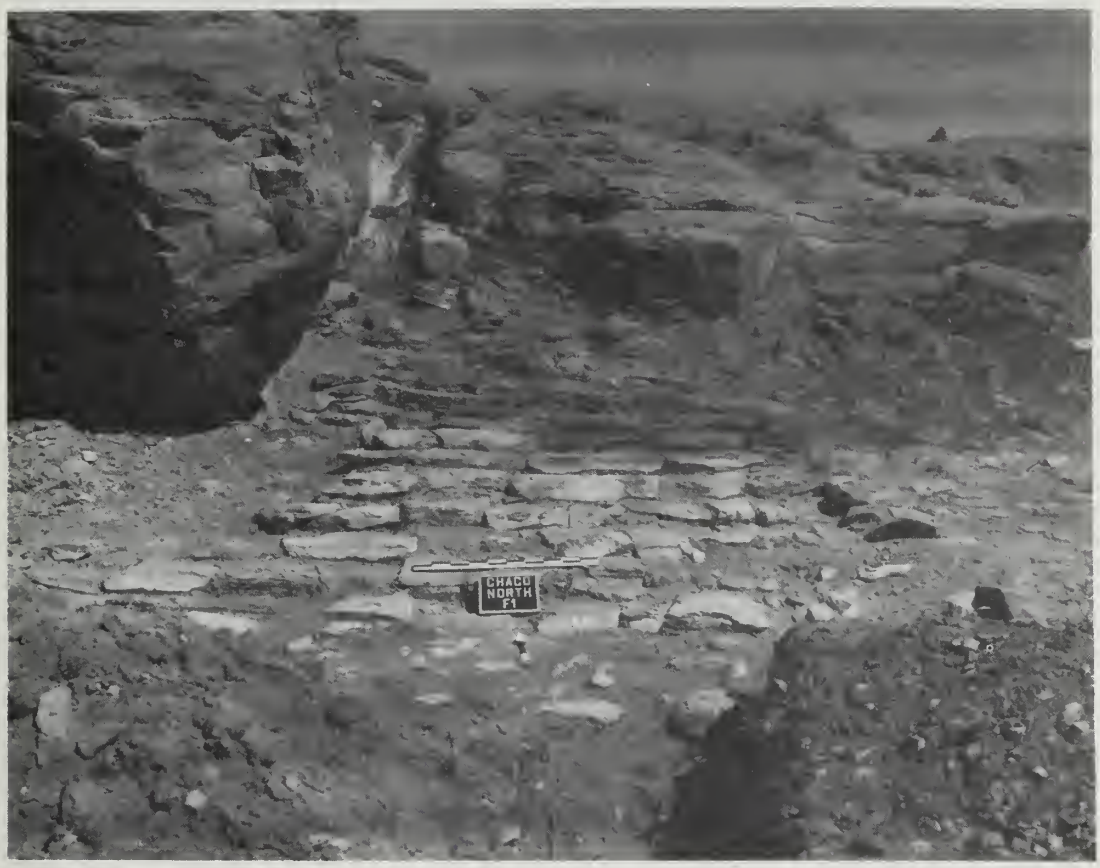


Figure A-6. Feature F-1, a set of masonry stairs located at the base of the slickrock near Chetro Ketl Ruin in Chaco Canyon. These stairs were excavated by Vivian and Buettner during their 1970-1971 field work.

Figure A-7. Jackson's Stairway, located at the head of a rincon behind Chetro Ketl Ruin in Chaco Canyon. Note incomplete staircase to the right.

masonry footings of a bridge (probably wooden planks) that spanned a canal below, and parallel to, the low ridge on which the great kiva, Casa Rinconada, was located. Bridge width, based on footing width, was 4.85 m. Though this feature may be correctly identified, association with a roadway is more tenuous, even though the width is very close to spur road width. The bridge may only have provided a means for crossing the canal, which was 4.6 m wide at this point. Conversely, the orientation of this feature is essentially on line with a "cut" in the low ridge on which Casa Rinconada is located. This cut may have been a route to the summit of the ridge; it was partially filled with backdirt from Casa Rinconada but remains fairly distinct. One can also (with slight juggling) line up the cut and the bridge with the space between the two walled refuse mounds in front of Pueblo Bonito. (The best location for a measurement between these two walled mounds is on the north, where distance between walls is approximately 10.67 m.) It is not inconceivable that there would have been a roadway between Pueblo Bonito and Casa Rinconada, or Rinconada and any other town for that matter. It has aready been noted the Tsin Kletzin-Rinconada branch of the South B Road on the SCS imagery appears as an almost direct route between this town site and the great kiva.

Outlying Roads. Several features identified by Holsinger, Judd, Gordon Vivian and others as roads or water control devices at locations some distance from Chaco Canyon were presumed in 1970-1971 to be part of a Chacoan road network but could not be linked definitely with roads in Chaco Canyon. One segment of road at an outlying site investigated in 1970-1971 was that at Kin Ya'a near Crownpoint. This segment had been identified by Holsinger as a canal, by Fewkes as a trail, and by Gordon Vivian as a canal. The kilometer of roadway that was traced here in 1970-1971 began southwest of Kin Ya'a, extended along the east side of the main structure, curved slightly to the northwest and then became indistinct in an eroded and washed section of valley bottomland. The road was well defined and bordered by low earth mounds south of the town. Width measured between these bordering ridges was about 10 m. Approximately 850 m south of Kin Ya'a the roadway crossed an area of exposed bedrock, and a short section (150 cm) of grooving cut in the sandstone was noted at this point. This groove was similar to the groove in segment B of the Pueblo Alto system. On a later flight north of Kin Ya'a two short section of what were believed to be extensions of this road were observed several kilometers north and west of the town. It appeared from the air that these sections were aligned on Fajada Butte in Chaco Canyon.

OTHER FIELD STUDIES

Vivian and Buettner's field work coincided with the initiation of two major Chacoan research projects (the National Park Service-University of New Mexico Chaco Center project and the San Juan County Museum-Eastern New Mexico University Salmon Ruin project), as well as accelerating archaeological contract work in the San Juan Basin stimulated by intensive mineral and oil exploration. Awareness of the potential scope of a Chacoan road network, its importance for explaining the evolution of the Chacoan cultural system, the need to more precisely define road and network attributes, and the inevitable loss of some road data through land modification projects all contributed to a variety of studies that concentrated on roads or considered roads as one aspect of broader investigation. These studies are summarized below in roughly chronological order, except that the Chaco Center remote sensing work, which extended over a number of years, is considered as one unit.

Prescott College

Though work on Chacoan roads was started by the Chaco Center prior to the investigations of Prescott College, the 1972 investigations by Gumerman and Ware of Prescott College were made under contract to the NPS and served to focus some of the later research by the Chaco Center; therefore the Prescott College research is considered first. It should be noted that a report on this work was submitted by Dr. George J. Gumerman and John A. Ware in December 1972 to the Chaco Center (Gumerman and Ware 1972). In 1977 this report was published by the Chaco Center in a volume on remote sensing work with the authors listed as Ware and Gumerman. The two reports differ very little except that the 1972 version contained a map of the project area and profile drawings of the test trenches cut across several roads. In addition, an appendix, "Suggestions for Future Archaeological Investigations at Old Pueblo Alto," appearing in the 1972 report was not published in 1977. Recommendations in this appendix are useful.

In 1972 the New Mexico Archeological Center (later the Chaco Center) contracted with Prescott College for a study to evaluate the capabilities of several types of remotely sensed data and interpretive instruments for defining prehistoric cultural features, primarily roads. Dr. Thomas R. Lyons at the Chaco Center and Dr. George Gumerman of Prescott College selected the Pueblo Alto road system for study, particularly that portion of this system just north of the town site, because several roads seemed to converge in this zone and a number of different

road features seemed to be present here.

Work was undertaken in three phases: 1) an aerial reconnaissance utilizing black-and-white and true color aerial imagery, multispectral photography, and data derived from an isodensitometer study of the Pueblo Alto area; 2) a ground survey conducted on foot to determine morphological characteristics of apparent land route sections; and 3) a series of test excavations designed to obtain profiles of road segments in order to determine the nature, consistency and range of variability in the archeological remains and their relationship to the imagery (Ware and Gumerman 1977:136).

Aerial photography, the ground survey, and to some extent the test excavations allowed Gumerman and his colleagues to assess the relative capabilities for identification and interpretation of multilevel imagery and ground-based observations. This "stratified series of observation platforms" included high altitude (1:32,000) and low altitude (1:3000) imagery and ground level or surface observation. To expand the assessment further, two sets of 1:32,000 black-and-white photographs (1930s SCS photography and others flown in 1959) and three sets of 1:3000 photos (black-and-white, color and multispectral) were used. To evaluate this data base, 18 road attributes for eight road segments in the Pueblo Alto system were compiled. "Each attribute was examined from the vantage point provided by each of the observation platforms, and the relative visibility of the attribute was noted. In this way, it was hoped that a list of attributes constituting a recognition pattern could be developed for each of the three observation platforms" (Ware and Gumerman 1977:139). The attributes fell into three broad classes: (1) gross morphological configurations of road courses, (2) direct or indirect consequences of alterations in natural drainage patterns, and (3) cultural features associated with roads such as bordering walls.

As expected, each of the three platforms had properties best suited for particular attributes. In general, high altitude imagery was most useful for delineating road linearity and length, and relationships between road segments and roads and large town sites. Low altitude imagery, especially when used stereoscopically, was useful in distinguishing low profile ground phenomena such as road depressions and was also the most suitable photography for discriminating attributes related to drainage alterations, including changes in vegetative density and species. Ground survey picked up low profile or small-scale features (usually cultural) that were extremely difficult, or impossible, to observe on aerial photography including potsherd concentrations, curbing, and rock-cut stairways. Ware and Gumerman (1977:151-152) concluded that while nearly all of the attributes could be resolved from a ground station, "the discrimination of most of these attributes at ground level would have been virtually impossible without the aid of aerial imagery."

The results of the true color and multispectral imagery experiments were not conclusive for several reasons (see Ware and Gumerman 1977:169-171), but continued experimentation was recommended. Similarly, while the isodensitometer studies did not produce especially useful results, the authors did suggest additional studies with more sophisticated equipment.

Eight one-meter-wide trenches were placed across seven road segments in the Pueblo Alto system, primarily to the north of the town site. In addition, a portion of a wall extending east from Pueblo Alto was trenched. This wall bordered the "plaza" on the east side of Alto and was the same wall traced by Gwinn Vivian in 1967. These tests were made to determine more precisely the characteristics and nature of Chacoan roads and to identify those variables that would "most directly influence aerial and surface resolution of the road system" (Ware and Gumerman 1977:161). The test showed that, in general, "actual roadbeds were extremely difficult to define," and that "formal preparation of the road surface was the exception rather than the rule" (Ware and Gumerman 1977:161-162). Road characteristics derived from the tests did not differ appreciably from those discovered by Vivian and Buettner. Ware and Gumerman concluded that the excavation results did not help them much in resolving aerial identification of roads.

The Prescott College study was especially timely and well-focused. The potential of aerial photography for defining a Chacoan road system was amply confirmed, and certain conditions, techniques and materials were identified as being important in future research using aerial imagery. For example, the authors confirmed that both time of day and season of year were critical in obtaining the most usable imagery. They concluded that while experimentation with color film should continue, the standard film should be panchromatic shot at a scale between 1:12,000 and 1:32,000. They further recommended that ground checking of roads would be accomplished most economically by using helicopter-assisted ground crews.

Chaco Center - Remote Sensing Project

Overview

Research in Chacoan archaeology planned by NPS and UNM and administered through the New Mexico Archeological Center (later the Chaco Center) included experimenting with the application of aerial remote sensing techniques to archaeological problems in the Chaco area. Vivian and Buettner's "rediscovery" of a possible network of Chacoan roads appeared to be an especially suitable subject for this study. Dr. Thomas R. Lyons, an NPS specialist in remote sensing, consulted with Vivian

and Buettner in 1970-1971 and then initiated a study of Chacoan roads as one aspect of a broader remote sensing program. (Other Chacoan remote sensing work included photogrammetric mapping of Chacoan sites and investigation of prehistoric water control systems.) Obenauf's (1980a) review of the initial phases (1971-1973) of this work is summarized below.

Lyons' work was part of a broader NPS investigation of remote sensing possibilities in archaeology which had been initiated by Dr. John Corbett, Chief Archaeologist of the National Park Service. Lyons began by comparing the SCS 1:32,000 imagery flown between 1934 and 1936 with USGS photography at the same scale taken in the 1960s. Vegetational differences were apparent and in general roads were more distinct on the earlier aerials. Lyons concentrated on an area within (but not limited to) the Chaco Canyon National Monument boundary and examined photography in most cases stereoscopically, a technique that Vivian and Buettner had employed only rarely. In May 1971 Stephen Shure, a graduate student at the University of New Mexico, was employed to continue photographic interpretation through the summer. During this time Lyons and Shure made several field trips to Chaco, and Obenauf (1980a:41) reports that "a recognition pattern for the roads began to emerge and some of the more visible roadway segments were mapped at this time."

Robert Hitchcock replaced Shure late in 1971 and:

"In April of 1972 the first of a series of flights was made over Chaco Canyon for the specific purpose of locating prehistoric roads. The new black-and-white photographs, flown at a scale of 1:6000, proved useful in mapping the complex network of roads within the Monument boundaries. Experimentation with scale, however, showed that the smaller scale imagery, such as the USGS imagery at 1:32000, was better suited for locating and mapping the roads" (Obenauf 1980a:41).

Some of the aerial imagery obtained in 1972 was used for the study of a possible irrigation system at the outlying town site of Kin Bineola. Analysis of this imagery and test excavations in features adjacent to Tear Drop Mesa, a small mesa southwest of Kin Bineola, led Lyons and Barde (1972) to conclude that the features at Tear Drop Mesa were not water control-related. Instead, Lyons suggested that the crescent-shaped mound and walled zone extending around the mesa were part of an "elaborate 'ceremonial way' for processions...in connection with associated shrines or other features of sacred geography" (Lyons and Barde 1972). Though study of Chacoan roads was carried out by the Chaco Center Remote Sensing Project (RSP) from 1971 to 1977, the focus of remote sensing research shifted somewhat, as noted by Obenauf (1980a:46-48) who commented that "The result of this change in direction was that the Remote Sensing Project mapped only a few additional miles of roadway between 1973 and 1977." The most concerted effort to gather data on and interpret Chacoan roads made by the RSP took place in 1973. The following summary of this work is derived from Obenauf's (1980a) M.A. thesis, project reports prepared in the late summer of 1973 by the three principals on the project [Randall Morrison (1973), James Ebert (1973), Robert Hitchcock (1973)], and miscellaneous notes on the project prepared by Morrison in 1979 (Morrison 1979). In addition, copies of the project Road Data Forms were reviewed as were maps of plotted linearities prepared by the project crew (Remote Sensing Project 1973). More interpretive reports by Lyons and Hitchcock (1977) and Ebert and Hitchcock (1980) are considered in Chapter 3.

1973 Survey

The goals of the 1973 project were (1) to evaluate the accuracy of remote sensing data for "recording" prehistoric cultural features, particularly roads, and (2) to better define the attributes of Chacoan roads and road-associated features. The first goal would ultimately lead to an imagery recognition pattern for roads, and the second goal would contribute to the on-going Chaco Center survey and data collection process. These goals were essentially those designed by Prescott College, and although a report had been submitted by the College on the results of the study in 1972 prior to the RSP field work, only Morrison refers to this project. The RSP research began in the spring of 1973 and included detailed photographic interpretation with empahsis on the use of special equipment, ground survey and light aircraft flights over the study area. All aspects of the project were continued into the summer. The field work did not include any subsurface testing.

In addition to the two basic research goals, each member of the team selected a more specific area of study. Morrison determined to investigate road orientation, concentrating on possible methods and procedures that may have been used prehistorically for "planning" road routes, particularly where long distances were involved. Ebert was interested in spatial interaction and the application of geographic models to a possible Chacoan road network. Hitchcock believed that a study of site relationships as determined through road linkages over time could produce information on prehistoric social systems in the Chaco area.

The boundaries of the study area were not defined in the field reports or subsequent publications, but Morrison's 1979 miscellaneous notes make it fairly clear that the original limits equated with the National Monument boundaries. Hitchcock states that "the entire Chaco Canyon region in which there were roads was systematically covered, with the exception of South Gap" (Hitchcock 1973:7). Ultimately, study area boundaries

came to be defined as encompassing the areas within eleven 7.5' USGS quadrangles identified and reproduced in Obenauf (1980b:152). Based on these quadrangles and Morrison's report and notes, it appears that investigation was concentrated on those areas where roads or possible roads had been defined by Vivian and Buettner. Essentially, all of Chaco Canyon was included, with intensive concentration on the zone between Penasco Blanco and Fajada Butte, or the lower half of Chaco Canyon. Areas outside the Canyon included a strip north from Pueblo Alto almost to the San Juan River, the Pueblo Pintado area, a strip north and west of Penasco Blanco toward Ahshislepah Canyon, the South Gap area, and a strip from La Mesita de la Junta to Kin Ya'a. A strip from Fajada Butte Gap to La Mesita de la Junta was field checked but did not appear on project maps; the section between Mesita de la Junta and South Gap appearing on the maps was not field checked. The RSP did identify numerous potential roads not located by Vivian and Buettner, and most of these were within the Canyon or near vicinity.

Work in the spring was concentrated on scanning available aerial photography for anomalous features, particularly those that appeared to be linear. These lines were plotted on USGS base maps (7.5' where available), and stairways located by the Chaco Center survey were also plotted. During the summer Ebert concentrated on laboratory work in Albuquerque, particularly on developing recognition patterns using a color density splicer and an edge enhancer, while Morrison and Hitchcock devoted most of their time to ground checking plotted lines and features and recording roads and road-related features. An information feedback system was developed to coordinate results of laboratory and field work. A Road Data Form was devised for recording field information, and a system for cataloging road segments was developed which referenced each segment by USGS quadrangle, and an "arbitrary grid designation of the section", the road number, and dependent sections of each road. Thus, road designation PB:3C:3c would refer to section c of the third road located within grid 3C of the Pueblo Bonito (PB) 7.5' quadrangle. Section c indicated that this particular road segment (3) had at least three sections or branches: a, b and c.

In addition to the ground truthing, three flights using light aircraft were made during the summer. The purpose of this work, which was sponsored in part by the National Geographic Society, was to identify, trace and photograph Chacoan roads, take publicity photographs of major Chacoan ruins, and experiment with different types of film, including black-and-white, color, black-and-white infrared and color infrared. Many of the roads visible on aerial imagery were observed on these flights. Furthermore, segments of roads thought to be prehistoric were noted in the Canyon bottom in the vicinity of Una Vida and Wijiji. Imagery produced from black-and-white and color film was useful; the black-and-white infrared results were of limited value, but some features on color infrared were much more distinct than on other imagery.

To adequately assess the contribution of the 1973 RSP work to the study of Chacoan roads requires consideration of what was plotted, what was verified and how verification was achieved. Unfortunately, none of the documents resulting from this project present this information in a straightforward or complete manner. Ebert (1973:24) reported that "we have mapped some 200 miles of prehistoric roadway at the present, about three times that mapped one year ago--and about 100 times that filed in the prehistoric site survey at the Chaco Center." Hitchcock (1973:24) added that "over 95 percent of the area that we wanted to check in the Chaco region was checked (only the South Gap area needs to be surveyed in part). We learned a great deal about the roads of Chaco Canyon and about the kinds of features associated with those roads." Morrison, on the other hand, consistently remarks on the difficulty of locating ground evidence for roads except on the very edges of Chaco Canyon where bedrock exposures and topographic relief increased the likelihood of features being more prominent. For example, Morrison (1973:10) states that "the road survey of the Alto area and the mesa top was a disappointment to the crew. The mesa top was the portion of the monument most intensely covered and yet failed to produce the results the imagery indicated it should." The following reconstruction of the project methodology for plotting and verifying roads is derived primarily from Morrison's 1973 field report and his 1979 notes. Linearities visible on aerial imagery, rather than roads, were plotted on USGS 7.5' topographic maps by Ebert in the laboratory. The distinction between linearities and roads is important because Ebert's linearities maps have been published several times (e.g., Obenauf 1980b:151-163; Ebert and Hitchcock 1975:50). As linearities were discovered on the imagery they were numbered in the manner described above, and linearity segment designations were then used on the Road Data Forms. The linearities maps were then sent to Chaco Canyon for ground verification by the field crew. [Maps with numbered segments were filed in the Remote Sensing Project office (Remote Sensing Project 1973), but reproductions of the segment maps, as in Obenauf (1980b), deleted the segment reference numbers.]

It is fairly clear that establishing what constituted ground "verification" of Chacoan roads had not been thoroughly resolved prior to the 1973 field work nor during that summer. This problem (which has characterized other more recent projects) probably resulted from an overdependence on road recognition criteria developed by Vivian and Buettner for roads in and near Chaco Canyon. Vivian and Buettner had shown several members of the RSP a number of Canyon roads. These

were characterized in the Canyon by masonry or rubble curbing, stairways and ramps, and outside the Canyon by the above features on occasion as well as pronounced swales which were often visibly enhanced by distinct vegetational differences. Though Gumerman and Ware had suggested techniques for ground verifying roads not characterized by these cultural features (based on their investigations north of Pueblo Alto where road segments were not always visibly evident at ground level), the RSP personnel failed to define extra-Canyon road recognition criteria. This deficiency was attributed in part by both Ebert and Hitchcock to a lack of formal road construction on segments beyond the immediate vicinity of Chaco Canyon or major outlying sites. Hitchcock (1973:12) concluded, "Thus, the bulk of the road system in Chaco Canyon can be seen as having been engineered. Apparently, the Chaco people would line themselves up on a point in the distance (such as Hosta Butte to the south or Huerfano Mtn to the north) and then walk in that direction. This might help explain the great width of the roads as well as the fact that there appears to be two or possibly more roads side by side running north from Pueblo Alto to Huerfano." Ebert (1973:6) concurs with this notion, stating "it is conceivable that hundreds of miles of such roadways were so 'unengineered' as to be totally lost to any recovery technique today."

That extra-Canyon road recognition had become a problem in 1973 is clear from Morrison's 1979 notes in which he describes one method of road verification.

"Outside the monument the situation differs radically. In the final three weeks of the 'road' survey it became apparent that merely verifying linearities and associated features had become redundant. In fact the field team by that point had forsaken the time-consuming method of walking down linearities and chose to investigate only those termini of linearities which crossed high topographic relief. This method...proved highly effective for locating the several categories of engineering employed by the builders. After the topographic method of verification was satisfactorily established and even more of the field season had lapsed the question of the physical existence of the roads became moot" (Morrison 1979:4).

A review of the Road Data Forms and Morrison's 1973 field report strongly suggests that the process of "walking down linearities" during the earlier weeks of the survey in many instances meant following a line plotted on a topographic map without observing any surface evidence of a prehistoric road. For example, Morrison (1973:6) reports that "all the ground between Alto and 'Painted Cliffs Mesa' was covered." The 1973 linearity maps show at least nine segments in this zone, but Morrison does not list the segments investigated. Instead, he states that "although the imagery quite distinctly showed many roads in the vicinity, the vegetation obscured any notable traces on the ground" (Morrison 1973:6). Only one road was confirmed in this general area (the limits of the area surveyed were not specified by Morrison or Hitchcock).

The "topographic method" was probably useful in the later stages of the field work when relatively long segments were surveyed. For instance, the South Road (Fajada Gap to Kin Ya'a) which was followed at this time did cross several areas with some topographic relief, and vestiges of the North Road were located in the vicinity of Pierre's Site, again a zone of increased topographic relief. The "topographic method" was essentially useless however on shorter segments that traversed country with little or no change in relief.

Incomplete and contradictory data sources preclude reconstruction of a complete record of what were verified as ground linearities in 1973. Obenauf (1980a:46) reports that "about half of the mapped roadway segments, or about 100 miles had been ground checked by the end of the summer of 1973." The most thorough reconstruction of what was verified was accomplished by Chris Kincaid for the present BLM study. She intensively reviewed the 1973 RSP field records and determined that the project had produced three general categories of results of field checks on linearities detected on aerial imagery. These were (1) results inconclusive, (2) linear features visible on the ground, and (3) linear features not visible on the ground. Kincaid further defined subsets of these categories based on cultural or temporal factors and color coded subsets of all linearities plotted by Ebert in the laboratory. This analysis provided a visual record of what was plotted and what was verified and not verified as a ground linearity. The results of this task do not correlate precisely with Morrison's description of segments surveyed in his 1973 report or with linearities "covered on ground and considered verified" on maps that were a part of his 1979 notes. Similarly, there is no complete correspondence of verified segments in Morrison's 1973 and 1979 documents. Neither is there a positive correlation between the various Morrison data and a recent map of Canyon-area segments published by Lyons (Morain, Budge and Komarek 1981:33, Figure 20). Because many of the lines shown on earlier versions of the Canyon road network do not appear on the Lyons 1981 map, it is presumed that the linearities shown are meant to represent verified Chacoan roads.

Though a complete synthesis of the 1973 recorded field data indicating what could and could not be seen would have been useful, a more critical deficiency of the 1973 project was the failure to distinguish between linearity recognition and road verification. This almost certainly was a major factor contributing to subsequent questioning of the existence of a Chacoan road system (see Flynn 1981). Ebert was a strong advocate of road

identification through aerial imagery analysis, and stated in regard to the Chaco work that "as aerial interpreters become more proficient at correctly identifying whatever they are identifying, ground-truth check becomes a less prominent phase of exploration." Unfortunately, "whatever they are identifying" had not been fully specified for Chacoan roads. Linearities were being defined in the imagery (in some cases) but roads often could not be defined on the ground. The more than 200 miles of "roads" mapped in 1973 included many miles of linearities visible on aerial photography that could not be confirmed on the ground as prehistoric roadways. Essentially, Ebert and Hitchcock concluded that linearities visible on aerial imagery that were in the vicinity of large Chacoan sites or that seemed to link these large sites were prehistoric roads even if they could not be confirmed on the ground as prehistorically constructed features.

In cases where the prehistoric origin of the roads could be confirmed, the presence of distinct cultural features was generally cited as evidence. Morrison's field report (1973) contains the most complete of segment studies, though supplementary data are given in the 1979 notes. This information has been used to compile Table A-3. Tabulating the data is the most efficient way of presenting the RSP field results, and it allows comparison with the Vivian and Buettner material.

An adjunct effort of the field checking included survey for locating stairways, steps and other means for traversing cliff faces in the canyon. This was a part of a broader plan to document features associated with roads, a plan that included Alden Hayes' request that the RSP field crew record "any sites encountered in the course of the road survey" (Morrison 1979:3). Most of the sites or features recorded were near roads and were thought to be road-associated. Both Hitchcock and Morrison listed road-associated features (including sites) in their field reports, and Morrison defined most of the feature terms he compiled. Table A-4 combines the Morrison and Hitchcock road-associated features list.

Post-1973 Studies

Lyons continued research on Chacoan roads in 1974; although aerial imagery was used for defining specific study areas, field work was limited to testing roads and possible road-related features at Pueblo Alto and Penasco Blanco. Richard Loose spent a week in May 1974 investigating the wall extending east from the northeast corner of Pueblo Alto. Ware and Gumerman had excavated a gate in this wall in 1972 and Chaco Center personnel wanted to better define the relationship of the wall to Pueblo Alto and to the roads focusing on the wall. Loose cleared portions of the wall for width measurements, sectioned it in one place to obtain construction data and excavated a north-facing extension on the wall east of the gate. This extension formed a small "room" open on the south or opening into the "east plaza" at Pueblo Alto.

The wall averaged 96 cm in width and existing wall fall was estimated to have stood at least a meter high. It was cored and faced on both sides; Loose does not indicate if a foundation was present, but profile drawings do not suggest a foundation. The "room extension" was approximately 28 m east of the gate. Loose referred to this structure as a "blockhouse" but concluded that it probably did not serve a defensive function since the walls did not appear to have stood over a meter high. Dimensions of this feature were approximately 4.75 by 5.3 m. Loose postulated that the wall served as a boundary marker for a plaza on the east side of Pueblo Alto. Testing convinced him that the walls extending east and west from Pueblo Alto were not walked on or used as causeways, a theory advanced earlier by Lyons. Loose could draw no direct association between the "blockhouse" and the roads coming into Pueblo Alto, but he did notice "that one of the roads that comes into Alto from the north may cross the wall just west of the blockhouse..." (Loose 1974).

Following this work Loose spent one day in July testing the Pueblo Alto-Chetro Ketl Road (Vivian and Buettner's segment B) just east of the junction with segment C. This test trench was probably very near a trench cut by Vivian in 1967. Loose "found the road to be 9.05 m wide and defined by a masonry curb on each side" (Loose 1974).

From Pueblo Alto, Loose moved to Penasco Blanco to continue road testing. This work was carried on intermittently for about two weeks. Based on his notes, Loose appears to have concentrated on testing the road segment identified as KK:4G:1 by the RSP field crew the previous summer. This segment, which passes just south of Penasco Blanco, seems to originate in the canyon bottom east of the town site as Morrison postulated, and may be an extension of road PB:4A-4B:1. The route of this road coincides with an historic Navajo wagon road for a short distance on the ascent up the cliff to Penasco Blanco. Another Navajo wagon road parallels the prehistoric road just west of Penasco Blanco on the Chacoan route down into the Chaco Wash after its junction with the Escavada Wash. Lyons and Hitchcock (1977, Figure 39) provide an aerial photograph illustrating the relationship of this road to the site.

Loose placed four test trenches across KK:4G:1 at its nearest location to Penasco Blanco. A great kiva situated just beyond the outer wall of the town may have been associated with the road and Loose extended one trench to this feature. A fifth trench (trench 4) was also cut near this kiva. In reconstruction, Loose (1974) tentatively identified two spur roads angling from the primary road (KK:4G:1) to the great kiva. The westernmost spur roughly follows the line

TABLE A-3

ROADS AND ROAD SEGMENTS IDENTIFIED BY THE RSP IN 1973

	RSP Name	RSP Number	Vivian and Buettner Identification
1.	Alto-Bonito[a/]	PB:3C:3a,b,c	Pueblo Alto System: Segments A-1, A-2
2.	Alto-Chetro Ketl	Not given in report	Pueblo Alto System: Segments B,C,D and E, possibly F.
3.	Great North	Not given in report	Chaco North
4.	Not given in report	PB:4D:2	Not reported
5.	Sandspit	PB:3F-4E-5E-5D-5C:2	Chetro Ketl
6.	Not given in report	PB:4E-5E:3	Not reported
7.	"Mini"	PB:5F-5G:3	Not reported
8.	Badlands	KK:3G-2G-2F-1F:1	Chaco West
9.	Penasco Blanco	KK:4G:1 KK:4G:2	Not reported
10.	Casa Chiquita	PB:4A-4B:1	Not reported except for isolated stairway 1763
11.	Tsin Kletzin	PB:6C:1 PB:7C:8 PB:7C:9	South B, Tsin Kletzin; Chetro Ketl-Tsin Kletzin South B, Tsin Kletzin: Rinconada-Tsin Kletzin
12.	West South Gap	Not given in report	South C; South Gap; South Gap to Kin Klizhin
13.	East South Gap	Not given in report	Not named, only briefly referenced
14.	Not given in report	PB:8F:1	Vicente Wash
15.	Latrine	PB:8E:1	Not reported
16.	Ya'a-Hosta	Not given in report	Kin Ya'a
17.	Ya'a-Chaco	Not given in report	Kin Ya'a
18.	Ya'a-Pintado	Not given in report	Kin Ya'a
19.	Pueblo Pintado	PP:2E:2	Not reported
20.	Pintado-Chaco	Not given in report	Chaco East

a/ Comments on each listed road or road segment are given in the following section.

COMMENTS ON TABLE A-3

1. Alto-Bonito: The RSP survey located an additional branch that apparently paralleled Vivian and Buettner's segment A-2. The associated features include some identified by Vivian and Buettner.

2. Alto-Chetro Ketl: Associated features reported by the RSP include those identified by Vivian and Buettner. Segment F or the Rim Road reported by Vivian and Buettner may not have been included by the RSP.

3. Great North: Morrison appears to have added the word "Great" to the Chaco North road. While Vivian and Buettner traced this segment only about one mile north of the Escavada Wash (to the vicinity of Kin Indian Ruin), the RSP plotted the roadway on aerial imagery to at least Gallegos Canyon (Huerfano Trading Post, NW quadrangle), hence almost to the San Juan River. Ground check according to Morrison (1973:6) proceeded "at various times to a mile or so past 402, but with no luck." (Site 402 is the Kin Indian Ruin.)

4. PB:4D:2: This seems to be the only segment in the "scramble of roads on the high ground NE of Chaco Canyon" (Morrison 1973:6) that the RSP was able to confirm on the ground. Boundaries of the area "NE of Chaco Canyon" are not given in RSP reports.

5. Sandspit: Vivian and Buettner only briefly investigated the more southern portion of this road segment. RSP identified two branches of the segment originating near the Curious Site (later renamed the Poco Site, 29 SJ 1010). The ramp at Bc86 identified by Vivian and Buettner was associated with the Sandspit road by the RSP.

6. PB:4E-5E:3: This linearity extended from a northwest tributary of Mockingbird Canyon to the Poco Site. It was located by the RSP on the ground but was predicted on the basis of an aerial linearity and the location of a small site presumed to be on the road.

7. "Mini": Morrison (1973:9) notes that only a quarter mile of this segment is visible on the imagery, and he states, "The Mini Road cannot be traced on the ground, of course, ..."

8. Badlands: Morrison and Ebert located the ramp in Ahshislepah Canyon that Vivian and Buettner predicted but could not find.

9. Penasco Blanco: Two segments were traced on the mesa top in the near vicinity of Penasco Blanco. Loose completed tests on KK:4G:1 in 1974. A "causeway" across the arroyo was reported for KK:4G:1.

10. Casa Chiquita: The investigated segment is one and a half miles northwest of Casa Chiquita and northeast of Penasco Blanco on the north side of the canyon. Linearities shown on the RSP maps of the cliff top directly north and west of Casa Chiquita are not discussed in the reports. RSP maps show segment PB:4A-4B:1 crossing the bottom of Chaco Canyon and connecting with segment KK:4G:2, a Penasco Blanco road.

11. Tsin Kletzin: Of ten linearities on South Mesa shown on the RSP maps six are not discussed in the field reports.

12. West South Gap: Several parallel lines are shown on RSP maps for this segment. Morrison (1973:14) remarks that "Mr. Ebert suggests that the road has moved laterally up and/or down slope through time." It is not clear if all lines shown were checked.

13. East South Gap: Vivian and Buettner identified this segment only on the basis of aerial imagery. A ground check by the RSP was apparently limited.

14. PB:8F:1: The road segment identified by Morrison was a portion of Lyons' "Upper Chaco Road" and Obenauf's "Chacra Face Road." Vivian, Lyons and Obenauf all traced this road on aerial imagery for some distance east of Fajada Butte on the south-facing talus slope of the Chacra Mesa. Morrison and Vivian field checked the segment extending north-south on the west side of Fajada Butte.

15. Latrine: Gordon Vivian traced a short segment of this road within the Fajada Butte gap but did not report it. Morrison believed that this road may have been the northern terminus of a road from Kin Ya'a, or the Ya'a to Chaco Road.

16. Ya'a-Hosta: This segment extends south of Kin Ya'a and ascends a mesa near the base of the Dutton Plateau. Vivian and Buettner traced this segment for less than a half mile south of the site.

17. Ya'a-Chaco: It appears that this road includes the segment from the Fajada Butte area to "La Mesita" in the Upper Kin Klizhin Wash (the Latrine Road is probably included) and the segment going north from Kin Ya'a to the Upper Kin Klizhin Wash. Hitchcock (1973:18) states that "one road was followed out in its entirety, the road from Chaco to Kin Ya'a." Morrison (1973:19), however, remarks that one section of this road identified on the aerial imagery "was never reached." The maps accompanying Morrison's 1979 memorandum do not show the entire route as verified. In one map the route is verified (presumably on the basis of associated features) but the linearity is not shown. The portion of road seen by Vivian and Buettner from the air north of Kin Ya'a was probably a part of this route.

18. Ya'a-Pintado: This road may have also been seen by Vivian and Buettner from the air. The RSP did not locate any evidence for the road on a ground check. The extent of the ground check is not specified in the field reports.

19. Pueblo Pintado: Gordon Vivian tentatively identified a short portion of this road which extends southwest of Pueblo Pintado and, as Morrison observes, curves. Vivian and Buettner could not locate any evidence for a prehistoric road in this area. This segment has been referred to at times as the "Quarry Road," though this term apparently has not appeared in published sources.

20. Pintado-Chaco: Associated features reported by the RSP include those noted by Vivian and Buettner.

TABLE A-4

ROAD-ASSOCIATED FEATURES

Steps	Lines of sherds
Stairs, stairways	Sherd areas
Toe/hand holes	Work areas (sherds and lithics)
Ramps	Alignment of stones c/
Viga holes (ladder supports at cliff edges)	Rock circles d/
Platforms	Semi-circular structures
Curbs	Overhangs (natural rest areas)
Walls along one or both sides	Single rooms
Cuts in rock a/	Small slab/masonry structures
Cuts through hills	Linear mounds (sites along the sides of roads)
Paving b/	Isolated small kivas
Grooves	Sharpening grooves
"Engineering"	Rock art
Burned areas	Shrines
Cairns	Springs
Hearths	

Source: Morrison and Hitchcock 1973.

a/, b/ - The "cuts in rock" and "paving" refer to features observed on road PB:4A-4B:1 north and west of Casa Chiquita where the roadbed was cut into the rounded top of a sandstone outcrop and clefts in this outcrop had been filled and "paved" with flagstones to maintain a level surface.

c/ - Morrison notes an alignment of stones in the roadbed of the Pintado-Chaco Road. This feature is most likely the stones that Gordon Vivian placed on white plastic paneling for aerial photography of this road segment taken in 1964. This alignment was noted in 1981 and correlated with paneling visible in the 1964 aerial photography.

d/ - Rock circles almost certainly refer to those large features described by Windes (1978) as stone circles and not to another feature Morrison has called "round roadside attractions." This latter feature does not appear in the 1973 road-associated feature list prepared by Morrison. Twelve of the 31 features compiled by Morrison and Hitchcock are probably road construction-related (engineering" could also likely be added to this category), while fourteen may have been road-associated through use or possible maintenance. The remaining four (sharpening grooves, etc.) seem only to have a tenuous relationship to roads.

of "inferred" road A-A' illustrated by Pouls, Lyons and Ebert (1976:112, Figure 5).

Tests of the main road showed it to be "about 9 meters wide" and cut into bedrock in some locations. No curbing was located where the road was cut into the sandstone but an earthen berm was present on the south side of the road in other locations, and adobe-rock bordering was found in the westernmost trench. There was some evidence that one of the spur roads led to a blocked doorway in the antechamber of the great kiva, but field notes made by an unidentified individual for July 1974 cite "an apparent gate for the spur road past the kiva in room 113."

References to other roads in the Penasco Blanco area appear in notes taken by Loose in mid-July 1974. On July 12 he mentions a road fork near Penasco Blanco and states that "one fork goes to the ruin--one goes to the shrine site Tom Windes dug last year." On July 29 he comments:

"This morning I followed the eastern road segment (the one which is just tangent to the Penasco trash mound), and found that it runs into the cliff just 50-100 meters up canyon from the sun-symbol petroglyph. [Loose is referring here to the supernova pictograph.] Enough rubble was strewn down the cliff face at strategic points to indicate that a stairway existed at the cliff. At the end of the road on the top of the cliff I found a small masonry construct which had been stablized!" (Loose 1974).

Research on Chacoan roads specifically undertaken by the Remote Sensing Project of the Chaco Center in 1975 and 1976 was limited to excavation of the Curious or Poco Site. This site, which is located at a high point of Pictured Cliff Mesa about three miles northeast of Pueblo Bonito and on the south side of the Escavada Wash, was located by the RSP field crew in 1973 during survey of the "Sandspit Road" (PB:3F-4E-5E-5D-5C:2) which appeared to connect Chetro Ketl with points north on the Escavada Wash. The site consisted of three low-walled circular masonry structures (probably never roofed) with some connecting walls. A small, low masonry platform and a few burned areas were cleared in "Circle C." There was little evidence for habitation at this site and it was assumed that it was associated with Chacoan land routes and visual communication. Obenauf (1980a:48) reports that it was situated on the "Chaco-Escavada" road, and Lister and Lister (1981:236) state that "a fork from one of the roads emanating from Pueblo Alto enters the site." The excavators, Dwight Drager and Thomas Lyons (1976:13), concluded that "the construction sequence of the road and the site could not be determined. It is still unknown whether the site was built before, after, or at the same time as the roads."

In 1978 the Remote Sensing Division obtained low level aerial stereo pairs of 43 sites, primarily Chacoan outliers, in the San Juan Basin. While this imagery was most useful for photogrammetric mapping of the sites, roadways could be defined within the immediate vicinity of some sites. This information was used by both Obenauf in her research on Chacoan roads systems and by the Public Service Company of New Mexico-Historic Preservation Bureau study of Chacoan outliers.

Chaco Center

Most Chacoan roadway research conducted by the Chaco Center was through the Remote Sensing Project as described above. Concurrent with the early stages of the remote sensing work was an intensive archaeological survey of the Monument and some adjacent areas, and this survey produced some roads data. Of 104 segments of roads or trails recorded by the survey, 48 were prehistoric; the others were Navajo. As reported by Hayes (1981:45-48) and as demonstrated in Figure 35 of his report, most road segments recorded by the survey were near the edges of the canyon and were almost always associated with steps, stairways or ramps. Most road segments shown in Figure 35 were "identified by aerial survey" and not by ground crews.

Hayes does provide some valuable information on road associated features-- primarily steps or stairways. Of the 148 step or stairway "sites," 20 were definitely part of an identified road system. Almost certainly, the 64 sites with masonry steps and the 45 locations with wide rock-cut steps were also road-associated. Hayes (1981:48) describes 11 sites with "an earth-filled masonry retaining-wall...placed at the foot of a stairway, probably for use as a ramp or landing-stage."

Sporadic road research was continued by the Chaco Center in 1977 and 1978. In June 1977 Robert Powers traced a portion of the South Road (Kin Ya'a to the South Gap) noting a division of the roadway at the Kin Klizhin Wash with one branch possibly going to the South Gap in Chaco Canyon and the other to Upper Kin Klizhin (Powers, Gillespie and Lekson 1983). Powers used the RSP Maps from 1973 and recorded a number of sites that were not reported by the RSP crew. In 1978 Thomas Windes investigated the road that traveled south of Kin Ya'a, following the route up the mesa edge. Windes also surveyed or tested road segments in the Pueblo Alto and Penasco Blanco areas during this general time period. In mid-July 1978, Gretchen Obenauf and Arthur Ireland (1978) studied Pueblo Alto roads for Windes. This work involved trenching one of the road segments entering the "East Plaza" of Pueblo Alto from the north. Field notes indicate that the trench was placed north of the east-west "East Plaza" wall. This work appears to have been done in the general vicinity of earlier trenching by Prescott College. Road curbing and surfacing resembled that reported by Ware and Gumerman. During the same summer Windes and Mathien excavated an additional trench at the

southwest corner of Alto. This trench crossed a prehistoric road lying perpendicular to an east-west trending wall, which radiated from the perimeter of the pueblo.

Obenauf and Ireland also staked the probable routes of three roads entering the "East Plaza" area and referred to these in their notes as road numbers 1, 2, and 3. A road designated as #4, corresponding to Vivian and Buettner's segment B, was traced from the Pueblo Alto refuse mound to its junction with segment C (Vivian and Buettner designation). Obenauf and Ireland then followed this road (segment C), labeled 4W, to the cliff edge above the talus unit noting the associated ramp (Vivian and Buettner feature C-1) and one set of steps (Vivian and Buettner feature C-3). The field notes also briefly mention road numbers 4WA, 5 and 6. All appear to be segments extending south and east of Pueblo Alto (no map accompanied the Obenauf and Ireland field notes).

Eastern New Mexico University (ENMU) - San Juan Archeological Research Center

Research undertaken by Dr. Cynthia Irwin-Williams at the Salmon Site, a major Chacoan outlier on the San Juan River in northwestern New Mexico, included a number of ancillary studies, among them investigation of Chacoan roads. In 1973 Irwin-Williams analyzed new aerial photography (color and color infrared) of a large zone surrounding the Salmon Site for indications of road networks. Segments of two roads were noted; one near the Aztec Ruins and a long roadway extending from Chaco Canyon almost due north to within 15 miles of the San Juan River (this was the North Road). Irwin-Williams predicted that this roadway continued to a known Chacoan outlier in Kutz Canyon and probably ultimately linked the Aztec and Salmon sites with Chaco Canyon. She reports that "limited examination of these roadways in this area indicates that they are wide (20-40 feet) causeways, cleared of rubble, and filled where necessary to level the surface, and that they are frequently bordered by ditches and/or mounds" (Irwin-Williams 1973b:14-15). According to Fred Nials (1982: personal communication) the area examined was roughly between Kutz Canyon and two to three miles north of Halfway House on the North Road.

In 1974 this research was continued by Pierre Morenon who concentrated his efforts on the "Chacoan-San Juan throughway" or the "Great North Road" traced the previous year by the Chaco Center RSP. Morenon was less concerned with establishing road feature criteria than previous investigators. He did appreciate the problem of verifying road segments located on aerial photography and proposed to define road segments in areas away from Chaco Canyon by investigating the distribution of material items associated with a road and not associated with a road. In addition, he was particulatly interested in the role roads played in a prehistoric society's definition and control of their social and natural environments. Twenty-two propositions in his Research Design (Irwin-Williams 1974:204-211; Morenon 1975) reflect this focus of interest. For the purpose of his study Morenon (1975:12) defined road as "straight segments linking settlements and/or topographic features, throughway as "continuous road segments connecting Chaco Canyon and the San Juan," and right-of-way (ROW) as a "strip of land 100 meters on each side of the road (measured from the center of the road)."

Field work was concentrated on approximately 50 km of the North Road between Pueblo Alto and Kutz Canyon. Morenon used the new stereoscopic color aerial photographs obtained by Irwin-Williams to define the general course of the "throughway." Then, to evaluate the "reality of the defined road" three ground analytical units were investigated: transects, sample grids and sites. Four transects 30 m by 30 m were placed perpendicular to both "definable" and "probable" road sections. At least eight transects had been defined, but collections were made in only four because three of the four selected (numbers 6, 7, and 8) crossed areas of "double roads." Samples were taken from both ROWs in the double roads. The "verified" road was then used as the "basis for stratifying the region and randomly sampling the region in terms of on-road and off-road sample areas of 200 m by 200 m" (Morenon 1975:2). Ten sample grids were placed on the road and twenty off the road. Both artifactual and ecological data were collected from the grids. The same types of data were then collected from sites within 100 m of the "throughway." No subsurface testing was done on the project.

Morenon (1975:5) determined that both pottery and lithics were good indicators of road surface "with pottery being a particularly strong indicator," that artifact weights decreased with increasing distance from the road, and that sites were spatially associated with the throughway.

School of American Research - McKinley County Survey - Survey of Section 16 (T. 19 N., R. 11 W.; McKinley County, New Mexico)

In August 1976 the School of American Research working for Phillips Petroleum Company, produced some evidence for a Chacoan roadway in areas to the north and south of the Bee Burrow Ruin, a Chacoan outlier. The feature was first recognized as a "linear swale between two low mounds of sandstone" (Beal 1976:16). The swale at this point was 2.5 to 3.0 m wide. Beal (1976:19) reports that "further examination of the survey areas (Section 16) resulted in both aerial and ground confirmation of the road's presence and its direction." Other than noting that a segment of the road in Section 3 appeared as a "slightly depressed swath populated by greener vegetation" (Beal 1976:19), no

further criteria for feature confirmation are given.

Aerial confirmation (presumably with aerial imagery) also led to the discovery that the road divided near the center of Section 16. Based on the bearings of the roads at this point, Beal predicted that the west fork entered Chaco Canyon through the South Gap and the right (or east) fork through the Fajada Butte gap. Beal was almost certainly on the Kin Ya'a to South Gap route, but his identification of a division in the road in Section 16 may be incorrect. Field work by the RSP in 1973, by Powers in June 1977 (Powers, Gillespie and Lekson 1983) and by the present BLM research project places the division of the South Road in Section 34 (T. 20 N., R. 11 W.) somewhat to the north and east of Section 16.

New Mexico State University, Las Cruces-Cultural Resource Management Division

In 1978, the Cultural Resource Management Division of the Department of Sociology and Anthropology, New Mexico State University (NMSU), conducted tests within the ROW of a proposed railroad in a zone north of Chaco Canyon. This ROW intersected several segments of Chacoan roads, including the North Road, and the project was designed to obtain data on "typical" roads for possible future mitigation projects (Brethauer 1978).

The rationale guiding the research was that previous criteria for distinguishing Chacoan roads (based on investigations in Chaco Canyon near large sites) were not suitable for identifying the hundreds of miles of "unimproved" roads extending out from the Canyon. It was pointed out that Morenon's research did not conclusively link presence or absence of ceramics with presence or absence of roads (a claim not made by Morenon) so that additional verifying evidence would be useful if it could be developed. Because such evidence might be present in subsurface exposures, four trenches were cut across three road segments north of the Escavada Wash. The segments were designated the western, middle and eastern. The western road equated with the North Road, the middle road veered northeast from the western branch on the north side of the Escavada Wash, and the eastern road was oriented roughly north and east toward Pictured Cliff Mesa. In designating the western route a "primary" road and the other two as "spur" roads, Brethauer confused road function with road size.

The trenches, which were three feet wide, extended well beyond the presumed limits of the road edges. Segments were located using aerial photography (1:4800), line-of-sight observations, and "a knowledge of the correct location as plotted on the USGS maps by Chaco Center archaeologists," though the features were "virtually invisible when viewed from the test area itself" (Brethauer 1978:26). No evidence for the presence of roads was found in any of the trenches. This included an absence of obvious constructional features or changes in soil color and texture. Brethauer concluded that the trenches had been placed across road segments visible on aerial imagery but that Chacoan road "construction," including paving, curbing, excavating or filling, had been quite limited. According to him most Chacoan road segments evolved through constant use of "the most efficient and direct routes between villages or from villages to resource areas" (Brethauer 1978:31).

Public Service Company of New Mexico-Historic Preservation Bureau (PNM-HPB)

Between October 1977 and July 1979 the Public Service Company of New Mexico (PNM) and the New Mexico Historic Preservation Bureau (HPB) jointly funded a survey of some portions of the San Juan Basin for the purpose of locating and documenting Chaocan communities. Both documentary research and field work was carried out by the principal field investigators, Michael Marshall, John Stein and Richard Loose. To avoid duplicating similar work by the Chaco Center, survey was concentrated in the southern Basin, particularly in the Red Mesa Valley, though investigation of the Chuska Slope was included. Project objectives included defining features characterizing Chacoan Anasazi communities. Roads were among the features defined as characteristic of Bonito Phase occupation.

Documentary sources and the Chaco Center aerial imagery archives were used to locate known or suspected outlying Chacoan sites for future field checking. Known road segments were studied for predicting possible locations of Chacoan outliers, and some aerial reconnaissance was completed for the purpose of identifying sites and obtaining oblique aerial photography. Sites were then field checked and recorded. Roads (known for some sites or proposed on the basis of aerial imagery) were recorded as one of the several community features.

Investigation of Chacoan roads by the PNM-HPB team, with few exceptions, was limited to those vestiges in close proximity to the prehistoric settlements. At the Standing Rock outlier, however, the field crew traced one of three roads entering the site for a distance of 12.5 km. A complete description of this segment is given by Marshall and his co-authors (Marshall et al. 1979:233). A segment at Coolidge Pueblo (Marshall et al. 1979:143) was fully traced, but it extended only from great kiva 2 to an area between two community house mounds. Roads were reported for 11 sites in four of the physiographic areas defined for the study area (Basin Floor, Chuska Slope, Red Mesa Valley, South Chaco Slope). Another roadway was predicted for the Lake Valley community but was not located. The PNM-HPB crew field recorded roads at eight sites (segments at the other three sites were known only from aerial imagery).

In most instances, roads were described as parabolic swales 4 to 6 m in width. They were most conspicuous when they cut through low hills or crossed locations with exaggerated relief. Extreme linearity of roads was also noted. At some sites, particularly Las Ventanas, masonry or other low curbing was present. A walled and slab-lined feature near Kin Bineola, termed "Avenida Kin Bineola" by the PNM-HPB team, was reported earlier by Gordon Vivian and Gwinn Vivian as a water control feature. Marshall et al. (1979:67-68), could find no reliable basis for this interpretation. PNM-HPB research determined that it was not unusual for more than one road to enter a site (for example, see discussion for Standing Rock on pages 231-233). Parallel or double roads are shown on the site map (Marshall et al. 1979:208) of the Muddy Water community and are reported for the Bee Burrow Site. Beal (1976) may actually have been seeing two parallel roads and not a division of roads near Bee Burrow (see discussion of School of American Research, McKinley County Survey).

Marshall and his co-investigators established that roadways were a definite feature of Bonito Phase communities (Chacoan outliers) in the San Juan Basin. Though not identifiable at all sites, they were probably present at most. Absence at some sites investigated does not preclude their former presence or eventual identification (in this regard see the following discussion of Obenauf's UNM thesis research). It was concluded that at least three major road systems tied outlying sites to Chaco Canyon--a road north to the San Juan River, one west to the Chuska Mountains, and a road south to the Dutton Plateau and probably beyond. When roads entered outlying communities--often from several directions--they most often passed near, or went directly to, the "public house," a structure characterized by Bonito Phase architectural attributes. A Research Design prepared by Loose (1979:355-362) includes four criteria for defining Chacoan roads in future research.

To avoid confusion in road "names" it should be pointed out that the "Chacoan West Roadway" (here referred to as the Casa del Rio to Lake Valley Road) passing near Casa del Rio and thought to be associated with the Lake Valley community (Marshall et al. 1979:32, 75) is not the same system as Vivian and Buettner's Chaco West Road (which is here referred to as the Penasco Blanco to Ahshislepah Road). Apparently following Morrison's lead, Marshall and co-authors refer to the road passing on the south side of Kin Ya'a as the "Great South Road." It is the same as Obenauf's South Road but Vivian and Buettner referred to it only as the Kin Ya'a Road.

Margaret Senter Obenauf-University of New Mexico Thesis Research

Analysis of aerial imagery by Gretchen Obenauf led to a thesis study of Chacoan roadways linking Chacoan outliers with large towns in Chaco Canyon (Obenauf 1980a). Obenauf began this work in 1977 when approximately 30 outliers were known and continued to add other outliers as they were discovered in the following two years. Essentially all of her work was done in the laboratory using a Dietzgen mirror stereoscope mounted on a scanning track. Three sets of imagery were used: USGS photography taken in the 1950s and 1960s at scales near 1:32,000, SCS aerials at 1:32,000 dating from the 1930s and the stereo pairs of outliers at 1:3000 and 1:6000 taken in 1977 for the Chaco Center Remote Sensing Project. The only imagery covering most of the San Juan Basin was that made by the USGS.

Obenauf developed a "recognition pattern" by examining known roads mapped by the Remote Sensing Project in 1973. She concentrated on the "Great North Road" and on the "South Road to Kin Ya'a." Recognition criteria included termini at a known Chacoan site, exceptional linearity, "dog-legs" rather than curves at changes in direction, and non-avoidance of low topographic obstacles. In addition, she determined that roads appeared as dark lines on photography and as slight depressions when viewed stereoscopically. Imagery with Chacoan outliers was examined for linearities near these sites and, if found, the linearities were traced to determine if they connected with other known Chacoan sites. All lines thought to be possible road segments were marked on the photographs and then transferred to USGS topographic quadrangle maps (7.5' when available).

Obenauf identified road segments (short linearities near and between sites) and road systems which were groups of segments that appeared to link a series of outliers with Chaco Canyon. In her reconstruction, these systems resembled the "spokes of a wheel" with Chaco Canyon at the wheel hub. Obenauf's systems probably would equate with Morenon's "throughways." Based on her research, Obenauf associated eight outliers with four previously defined systems--the North Road (Pueblo Alto to the Salmon Site), the South Road (South Gap to Kin Ya'a), the East Road (Chaco Canyon to Pueblo Pintado), and the West Road (Penasco Blanco to Ahshislepah Canyon). Vivian and Buettner's major divisions were followed, though the point of Canyon entry on the South Road was not defined by them.

Four new systems were postulated on the basis of the aerial imagery analysis. These were the "Coyote Canyon Road" (Chaco Canyon to

Grey Ridge community by way of the Standing Rock and Peach Springs outliers), "Mexican Springs Road" (Chaco Canyon to Mexican Springs community via Kin Bineola and the Indian Creek community), "Casa del Rio Road" (a western roadway that probably linked Chaco Canyon with Lake Valley and Casa del Rio), and the "Southeast Road", which left Chaco Canyon at the Fajada Butte Gap, passed the Greenlee outlier and then divided with a western branch to Kin Ya'a and an eastern branch to the "San Mateo-El Rito-Kin Nizhoni complex." Obenauf also located what appeared to be road segments near several outliers investigated by the PNM-HPB study team for which no evidence could be found on the ground at the time of their investigation. These roads were near the Indian Creek, Hogback, Casamero, Andrews and Kin Nizhoni Sites.

Obenauf concluded that additional outliers could be expected to be found on several of the road systems. Spacing of outliers on both the North Road and the South Road was rather regular, averaging about 10 1/4 miles between sites. This consistency in spacing was not repeated on several "new" systems, but these systems had not been ground checked to the degree that the North or South Roads had. Obenauf also believed that alluviation and erosion may have obliterated many road segments--some quite recently. She noted (Obenauf 1980a:60-61) that a road segment near the Hogback outlier visible on SCS imagery taken in the 1930s could not be seen on USGS photography flown in the 1960s (though factors other than alluviation and erosion may have accounted for this loss of visibility as well). Prediction for additional outlier and road systems are made in Obenauf's thesis, and an Appendix in her document contains reduced copies of USGS quadrangle maps with possible roadway segments marked on them.

Leo Flynn-Bureau of Land Management (BLM)

At about the time that Obenauf was undertaking her thesis photointerpretation research Leo Flynn, then an Archaeologist for the BLM, was conducting a similar study. Flynn's results were different from Obenauf's. His study was motivated by the BLM's need to manage cultural resources within coal lease areas under its jurisdiction. "Linearities" within the Bisti-Star Lake coal lease area had been identified, primarily through photointerpretation, as Chacoan roads. Flynn was concerned with the practical problems of ground recognition and analyzed aerial imagery to support his proposition that while "there are substantial numbers of linearities in the coal lease area that have the same attributes as those linearities identified as Chacoan roads...there is no common agreement at this time on criteria for distinguishing even 'obvious' historic roads from presumed prehistoric roads" (Flynn 1981:1-2).

With respect to methodology, Flynn argued that previous "recognition criteria" for identifying Chacoan roads had been developed largely on the basis of viewing aerial photographs with limited or no ground checking to verify conclusions drawn from imagery analysis. He also pointed out that the lack of archival research on historic roads and road patterns in the area limited the ability of past researchers to identify historic roads. Flynn maintained that until reliable methods were developed for distinguishing between historic and prehistoric roads, no management plans for these features could be justified. He concluded that "the chronological and cultural implications of these associations require evidence which, for the most part, can be collected only on the ground and through archival research" (Flynn 1981:9).

Judging from data presented in his report, it appears that Flynn concentrated most of his research efforts on photointerpretation, although he does not indicate precisely what field work he did. From casual comments, it is clear that he (or an informant) visited some locations along the North Road in the vicinity of Pierre's Site, and he refers to travel "over a jeep trail which is largely coincident with the 1930s linearity" (Flynn 1981:26). He did begin archival research by plotting historic roads shown on eight regional maps on a base map with a scale of 1:250,000. The preliminary results of this procedure suggested to Flynn that several roadways "shown in historic records coincide with linear features currently called Chacoan roads" (Flynn 1981:20). These included the North Road, the road at Kin Ya'a, several segments near San Mateo and others. Flynn used a Bausch and Lomb SIS 95 Stereoscope with 2x objectives and 10x eyepieces to inspect SCS and Soil Erosion Service aerial imagery for linear features. This imagery, flown between 1934 and 1936, was mostly at scales of 1:28,000 to 1:32,000. Linear features observed were marked in pencil on one photo of each stereo pair. A Baush and Lomb Zoom Transferscope was then used to transfer linear feature locations to sepia copies of 1:24,000 scale orthophoto maps, the aerial photography for which was flown in 1975. Linear features were marked on the orthophoto maps in pencil. This process--and the results--apparently convinced Flynn that "standard archaeological procedures" were necessary for "determining the age of roads and trails" (Flynn 1981:12).

Much of Flynn's report is devoted to a discussion of six "methods" that could be employed to obtain cultural and chronological data for road studies.

A synopsis of his methods, arguments and some examples follow:

1. "Stratigraphic position": Flynn noted that stratigraphic studies on Chacoan roads have been "conspicuously missing." Commenting that road segments tested in Chaco Canyon had been in upland areas, he argued that sedimentation in the canyon bottom may have covered and preserved evidence of roads,

presuming that earlier erosion cycles did not remove them entirely. On the other hand, he cited a lack of evidence for road surfaces in arroyo cut exposures on the "alleged route of the Great North Road" (Flynn 1981:14).

2. "Diagnostic materials and workmanship": Because he did not have access to the Vivian and Buettner data, Flynn was not able to show conclusively that ramps, curbing and other road-associated construction exhibited the same workmanship and utilized the same materials as found in other Bonito Phase building. He recommended re-study of the 1973 Remote Sensing Project field data for confirmation of Bonito Phase origins for these features.

3. "Diagnostic use traces": The rationale for this "method" was that historic road travel with wheeled vehicles would leave distinctive ruts, "use traces," which in some instances would be preserved and could be used to confirm a historic date for the roadway. Examples of historic roads in the Chaco area that could be studied were given.

4. "Records of use": Archival research on historic road routes and use and compilation of maps showing historic roads were recommended.

5. "Physical/functional association with dated objects": Flynn questioned dating roads by association with structures or ceramics unless "quite explicit physical (including stratigraphic) and functional associations" could be demonstrated. Morenon's transect study was faulted for not taking "into account the influence of the presence of sites on the number of sherds found in an area" (Flynn 1981:22). On the other hand, Flynn presented an example of functional relationships between roads and other features wherein he supposedly traced the North Road through a Navajo compound with a turn-off "directly into the corral" (Flynn 1981:23). This site, subsequently named "Leo's Hogan," was extensively studied during the current project (see Chapters 6 and 8).

6. "Obstacles to travel": The non-avoidance of topographic obstacles on Chacoan road routes (resulting in their remarkable linearity), a feature cited by other researchers as evidence of their pre-wheel antiquity, was debated by Flynn. Essentially his view was summed up by a quote from Schmedding that he gave in his report, "Surely a wagon ought to be able to travel over the same trails as a saddle horse" (Schmedding 1951:89-90).

Flynn's concluding recommendations were aimed principally at compiling additional data on historic road use and historic settlement patterns in the San Juan Basin. While he justifiably questioned some previous methodology and conclusions drawn from earlier studies, and rightly stressed the need for historic research, his own study was not without bias. Simple examination of exposed features in Chaco Canyon would have made it clear that roadways were a feature of the Bonito Phase. Extension of a road system beyond Chaco Canyon would have required greater confirmation of cultural affiliation and antiquity, but some fairly conclusive data were available at the time of Flynn's work. His questioning, fortunately, did stimulate additional research.

APPENDIX B

FIGURE B-1 Soil Description Form Used in Description of Trench Profiles.
Modification of Standard Soil Survey Form (Department of Agriculture 1951:139-140)

LOCATION TRENCH 12, SOUTH WALL, 0 METERS | DATE 11/10/81 FN

SIGNIFICANCE OF SECTION JUST OUTSIDE THE EASTERN BERM

NATIVE VEG.

ELEV. | RELIEF | SLOPE

Horizon	Depth	Thickness	Boundary	Color: Check D (ry) or M (oist)	Texture	Structure	Consistence	Reaction	Special Feature
1			c s	D 10 YR 6/4 M 10 YR 5/3	fls	1 m c r	dso mvfr wsss wpo	ve	post-road
2			c i	D 7.5 YR 5/6 M 7.5 YR 4/4	fsl	2 m-c, pr [b/]	dsh mfr-mvfr wss wsp	0 [c/]	
3 BEDROCK				D M					
				D M					
				D M					
				D M					
				D M					
				D M					
				D M					

REMARKS (sketch of strat. section on other side):

b/ Breaking to m-c pl, especially in upper 5 cm.

c/ Pre-road B.

Samples Taken - Horizons 1 & 2

FIGURE B-1 Soil Description Form Used in Description of Trench Profiles.
Modification of Standard Soil Survey Form (Department of Agriculture 1951:139-140)

LOCATION TRENCH 1, SOUTH WALL, 3 METERS | DATE 11/9/81 FN

SIGNIFICANCE OF SECTION TRENCH ACROSS NORTH ROAD, EAST BERM

NATIVE VEG.

ELEV. | RELIEF | SLOPE

Horizon	Depth	Thickness	Boundary	Color: Check D (ry) or M (oist)	Texture	Structure	Consistence	Reaction	Special Feature
1			a-c w	D M	ls	1 fcr	dlo mvfr wso wpo	0	
2			a i	D M	l - cl	2-3 m-c sabk d/	dsh mfr wss wsp	e to es e/	2 - n pf
3			a i	D M	s c	lan, alt, s and c, H_2O dep	dso mfr; dh msh wso wpo; ws wvp?	ve - sand es - clay	
4			unobserved	D M	scl	3C pr (3m abk)	dvh mh wvs wvp	0 to ev f/	
				D M					
				D M					
				D M					
				D M					
				D M					

REMARKS (sketch of strat. section on other side):

d/ Sabk - Structure is quite variable, appears to be some restructuring plus mixing with sandy material.

e/ Increases with depth.

f/ Carbonates concentrated in discrete white 1-3 mm rounded "pellets".

FIGURE B-1 Soil Description Form Used in Description of Trench Profiles.
Modification of Standard Soil Survey Form (Department of Agriculture 1951:139-140)

LOCATION TRENCH 1, SOUTH WALL, 10 METERS | DATE 11/9/81 FN

SIGNIFICANCE OF SECTION WITHIN FORMER ROADWAY

NATIVE VEG.

ELEV. | RELIEF | SLOPE

Horizon	Depth	Thickness	Boundary	Color: Check D (dry) or M (moist)	Texture	Structure	Consistence	Reaction	Special Feature
1			c w	D M	s	1 f cr	dso mvfr wso wpo	ve	
2			g	D M	s	1 f cr	dso mvfr wso wpo	o	
3			v a i	D M	s c	1 a m. c and s, H_2O dep.	dsh mvfr dh msh wso wpo wvs wrp?	o - sand es - clay	slightly h/ cemented
4			unobserved	D M	c	g/	deh meh wvs wpo	o to ev	g/
				D M					
				D M					
				D M					
				D M					
				D M					

REMARKS (sketch of strat. section on other side):

g/ See notes for Horizon 4, Profile at 0 meters.

h/ Charcoal at approximately 10.75 meters on boundary with Horizon 4. Approximately 1.5cm x .5cm by ? Check for C_{14} sample potential.

FIGURE B-1 Soil Description Form Used in Description of Trench Profiles.
Modification of Standard Soil Survey Form (Department of Agriculture 1951:139-140)

LOCATION TRENCH 12, SOUTH WALL, 10 METERS | DATE 11/10/81 FN

SIGNIFICANCE OF SECTION TOWARDS WESTERN MARGIN OF ROAD

NATIVE VEG.

ELEV. | RELIEF | SLOPE

Horizon	Depth	Thickness	Boundary	Color (Check D (ry) or M (oist))	Texture	Structure	Consistence	Reaction	Special Feature
1			C S	D 10YR 6/4 M 10YR 5/4	fls	1f-m, cr-sg	dlo mvfr wso wpo	O	
2			C-a, w-i	D 10YR 6/6 M 10YR 5/6	fsl	1-2, m-c, sbk	dsh mvfr wsss wsp	O	a/
3			unobserved	D 2.5Y 7/4 M 2.5Y 5.5/4	flaggy ss mixed with ssh			ev	
				D M					
				D M					
				D M					
				D M					
				D M					
				D M					

REMARKS (sketch of strat. section on other side):

a/ Post road fill contains occasional small pebbles and sandstone cobbles. Depositional structure observed in most areas by pedogenesis, occasionally thin laminae in sand visible near base of fill. Most fill appears to be of mixed colluvial and aeolian origin. Very interesting spot.

Samples Taken - Horizons 1 & 2

TABLE B-1

SOILS ASSOCIATIONS AND COMPLEXES CROSSED BY PREHISTORIC ROADS NORTH OF CHACO CANYON

Blancot-Notal Association

Blancot-Notal association, gently sloping. This map unit is on fans and in valleys. Slope is 0-5 percent. 5,600-6,400 feet. The average annual precipitation is about 8 inches, the average annual air temperature is about 53 degrees F, and the average frost-free period is about 150 days.

The Blancot soil is deep and well drained. It formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is pale brown loam about 2 inches thick. Subsoil is pale brown, brown and light brownish gray clay loam about 13 inches thick. Substratum to a depth of 60 inches or more is light grayish brown and grayish brown sandy clay loam and clay loam.

Permeability-moderate
Available water capacity-high
Effective rooting depth-60 inches +
Runoff-medium
Water erosion hazard-moderate
Soil blowing hazard-moderate
Average annual wetting depth-16 inches
Potential plant community-western wheatgrass, galleta,
Indian ricegrass, and fourwing saltbush
Disturbance increaser plants-big sagebrush, Douglas rabbitbrush, broom
snakeweed, and annual forbs.

Notal Soil

The Notal soil is deep and well drained. It formed in alluvium derived dominantly from shale and sandstone. Typically, the surface layer is brown silty clay loam about 3 inches thick. The subsoil is grayish brown clay about 20 inches thick. The substratum to a depth of 60 inches or more is grayish brown clay.

Permeability-very slow
Available water capacity-very high
Effective rooting depth-60 inches +
Runoff-medium
Water erosion hazard-moderate
Soil blowing hazard-severe
Salinity-slight
Average annual wetting depth-6 inches (where there is a cover of natural
vegetation)
Potential plant community-alkalai sacaton, galleta, black greasewood, and
western wheatgrass.
Disturbance increaser plants-black greasewood, big sagebrush, Douglas
rabbitbrush, and annual forbs.

Doak-Avalon association gently sloping

This map unit is on mesas, plateaus, and terraces. Slope is 0-5 percent. Native vegetation is mainly grass. Elevation is mainly 5,600-6,400 feet.

Doak Soil

The Doak soil is deep and well drained. It formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 5 inches thick. The subsoil is brown and light brown silty clay loam and clay loam about 38 inches thick. The substratum to a depth of 69 inches or more is light yellowish brown clay loam.

Permeability-moderately slow
Available water capacity-very high
Effective rooting depth-60 inches or more
Runoff-slow
Water erosion hazard-slight
Soil blowing hazard-moderate
Average annual wetting depth-16 inches
Potential plant community-blue grama, western wheatgrass, Indian ricegrass, and
needle and thread

Disturbance increaser plants-broom snakeweed, big sagebrush, rabbitbrush and
annual forbs.

Avalon Soil

The Avalon soil is deep and well drained. It formed in alluvial and eolian sediments derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 4 inches thick. The upper 22 inches of the substratum is pinkish white loam. The lower part to a depth of 60 inches or more is light yellowish brown loam.

Permeability-moderate
Available water capacity-high
Effective rooting depth-60 inches +
Runoff-medium
Water erosion hazard-moderate
Soil blowing hazard-high
Average annual wetting depth-about 18 inches
Potential plant community-Indian ricegrass, winterfat, galleta, and blue grama.
Disturbance increasers-Mormon-tea, broom snakeweed, threeawn, and annual grasses.

Doak-Sheppard-Shiprock Association, Rolling.

This map unit is on mesas, plateaus, and terraces. Slope is 0-15 percent. Native vegetation is mainly grass.

Sheppard Soil

The Sheppard soil is deep and somewhat excessively drained. It formed in eolian material derived from mixed sources. Typically, the surface layer is light yellowish brown loamy fine sand about 3 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown and light yellowish brown loamy fine sand and fine sand.

Permeability-rapid
Available water capacity-low
Effective rooting depth-60 inches +
Runoff-slow
Water erosion hazard-slight
Soil blowing hazard-very severe
Average annual wetting depth-approximately 30 inches
Potential plant community-Indian ricegrass, giant dropseed, alkalai sacaton, and needle and thread.
Disturbance increaser plants-Mormon tea, sand sagebrush, big sagebrush, and annual forbs.

Shiprock Soil

The Shiprock soil is deep and well drained. It formed in alluvial and eolian material derived dominantly from sandstone. Typically, the surface layer is brown fine sandy loam about 3 inches thick. The subsoil is brown fine sandy loam about 9 inches thick. The substratum to a depth of 60 inches or more is light brown and very pale brown fine sandy loam and sandy loam.

Permeability-moderately rapid
Available water capacity-moderate
Effective rooting depth-60 inches +
Runoff-slow
Water erosion hazard-slight
Soil blowing hazard-severe
Average annual wetting depth-about 13 inches
Potential plant community-Indian ricegrass, blue grama, giant dropseed, and fourwing saltbush.
Disturbance increaser plants-big sagebrush, broom snakeweed, rabbitbrush, and annual forbs.

Huerfano-Muff-Uffens Complex, Gently Sloping.

This map unit is on mesas and in valleys. Slope is 0-8 percent. Native vegetation is mainly grass.

Huerfano Soil

The Huerfano soil is shallow and well drained. It formed in alluvium and residuum derived dominantly from shale and siltstone. Typically, the surface layer is light yellowish brown sandy clay loam about 1 inch thick. The subsoil is dark yellowish brown, brown and yellowish brown clay loam and sandy clay loam about 13 inches thick. Shale is at a depth of 15 inches.

Permeability-moderately slow
Available water capacity-very low
Runoff-medium
Water erosion hazard-moderate
Soil blowing hazard-severe
Average annual wetting depth-about 4 inches.
Exchangable sodium-25-75 percent
Potential plant community-mainly alkalai sacaton, galleta, fourwing saltbush, and black greasewood.
Disturbance increaser plants-black greasewood, shadscale, broom snakeweed, and annual forbs.

Muff Soil

The Muff soil is moderately deep and well drained. It formed in alluvium derived dominantly from shale. Typically, the surface layer is pale brown very fine sandy loam about 3 inches thick. The subsurface layer is light gray very fine sandy loam about 1 inch thick. The subsoil is brown and light brown clay loam about 20 inches thick. Shale is at a depth of 24 inches.

Permeability-slow
Available water capacity-low
Effective rooting depth-20-40 inches
Runoff-medium
Water erosion hazard-moderate
Soil blowing hazard-severe
Average annual wetting depth-approximately 6 inches
Exchangable sodium-25-75 percent

Uffens Soil

The Uffens soil is deep and well drained. It formed in alluvium derived dominantly from shale. Typically, the surface layer is pale brown and light yellowish brown fine sandy loam and very fine sandy loam about 8 inches thick. The subsurface layer is light gray very fine sandy loam about 11 inches thick.

The substratum to a depth of 60 inches or more is pale brown sandy clay loam.

Permeability-moderately slow
Available water capacity-low
Effective rooting depth-60 inches +
Runoff-slow
Water erosion hazard-slight
Soil blowing hazard-severe
Average annual wetting depth-approximately 12 inches
Exchangable sodium-25-75 percent
Potential plant community-alkalai sacaton, galleta, black greasewood, and fourwing saltbrush.
Disturbance increaser plants-black greasewood, shadscale, broom snakeweed, and annual forbs.

Source: Keetch 1980.

APPENDIX C

APPENDIX C

INTRODUCTION

The following descriptions are presented here to provide examples of the structural classes discussed in Chapter 9, and to expand the published data base of Chacoan architectural manifestations on the Basin floor.

Unlike material culture, architecture cannot be collected, curated and thus analyzed at the investigator's convenience. Recent studies by Hayes and Windes (1975), Windes (1978), and Marshall et al. (1979) demonstrate that traditional nomenclature is no longer sufficient to describe the known architectural complexity of the Bonito Phase. Lekson (1977a:2) stresses that the methods available for the documentation of architectural attributes are 25 years behind the detailed analysis techniques used for portable artifacts. Clearly if we intend to interpret and ultimately manage the remains of Chacoan society a set of internally consistent criteria for describing architectural variability must be developed.

Many of the architectural forms characteristic of the Bonito Phase are simple in construction but formal in lay out. Although they may have some characteristics in common with functionally dissimilar but contemporaneous forms (e.g., Avanzadas and simple roomblocks) or even with non-contemporaneous forms (e.g., Herraduras and hogan foundations) application of consistent criteria will reduce judgment error and result in a more reliable data base.

The following descriptions represent a composite of newly located and described structures, and structures which had been previously described but were re-evaluated during the course of this project. For the more complex structures, principally great houses, mapping was accomplished through the use of an alidade. Lesser structures were generally mapped using a Brunton and chain, with a few exceptions which were pace-mapped. Material culture analysis was accomplished in the field. As a rule each separate midden and the house mound were sampled independently. Quadrats were utilized on middens to facilitate ceramic density estimates. Lithic material was generally so sparse that an entire midden locus or the entire site area was used as the sample boundary. Temporal affiliation was assigned utilizing the method suggested by Marshall (Marshall et al. 1979:257), augmented by methods described in Chapter 9 of this report. For certain sites a commentary is provided which contains observations about salient architectural characteristics, comparisons with other structures, interpretation issues, site condition or road association. Many of these observations are repeated in the text.

We wish to thank individuals who were generous enough to volunteer their time to assist in the documentation and reconnaissance efforts of this project. Their contributions are acknowledged where appropriate on the site descriptions and maps.

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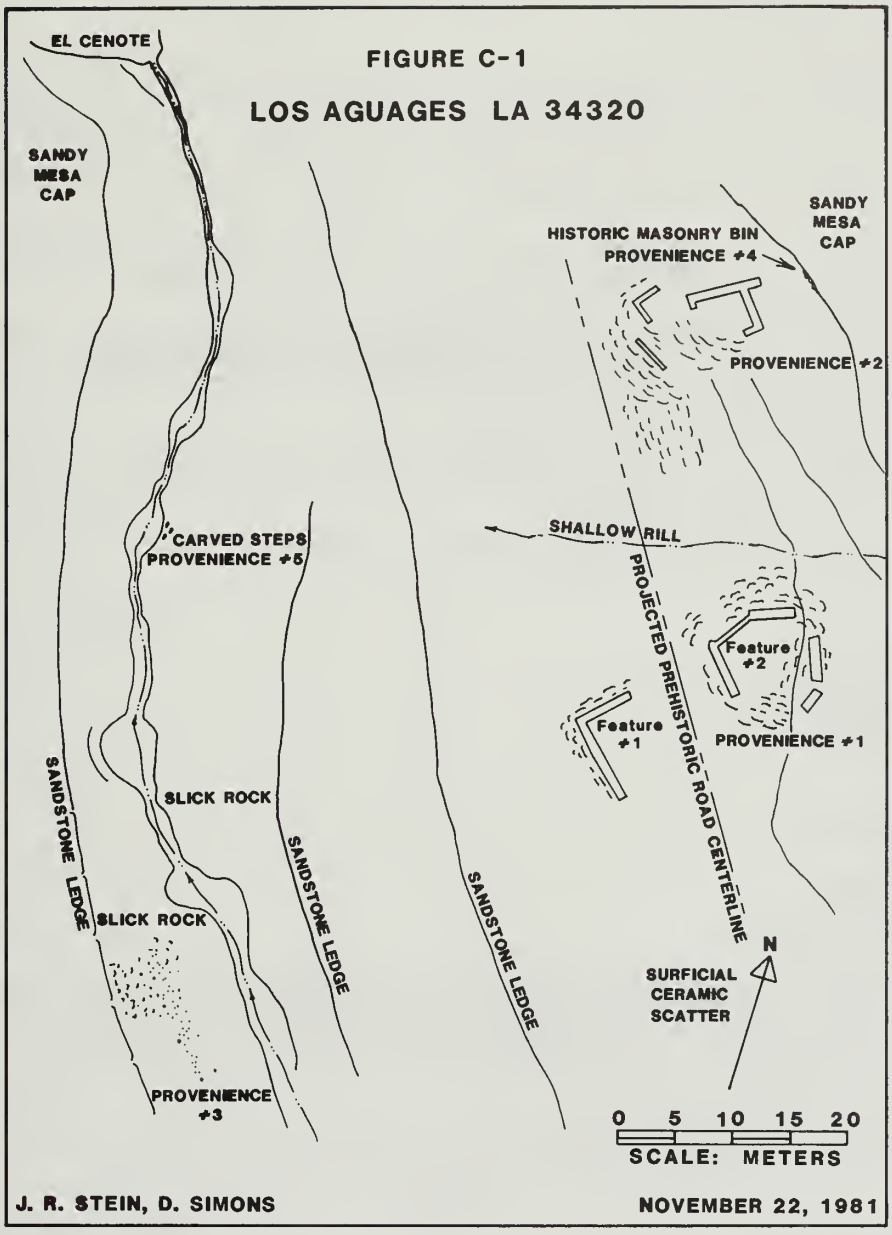
Site Name: Los Aguages
LA Number: 34320
Other Numbers: CRP Field No. PB-AH 13
Recorder: John R. Stein, Daisy F. Levine, David Simons
Temporal Affinity: Marshall: 1000-1125 AD; Weighted method: 1090 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Penasco Blanco to Ahshislepah Road
Topographic Situation: Structures are located below a low ledge flanking a lateral drainage to the Ahshislepah Wash. Here the drainage is incised into the sandstone substrate and forms a series of natural "tanks." The structural remains of Los Aguages are situated on the slickrock shelf above these tanks.
Visible Horizon: Visibility from the area of the structural remains is restricted.
Soil Structure: Shallow sand over slickrock substrate
Vegetation: Grasses, saltbush
Primary Drainage: Lateral to Ahshislepah Wash
Elevation: 6220'
Site Description: The site area recorded as Los Aguages consists of 5 proveniences (see Figure C-1):
1) Bonito Style Structure No. 1;
2) Bonito Style Structure No. 2;
3) reduced structural remains on slickrock;
4) a possible historic storage feature; and
5) a set of steps pecked into the bedrock above the tanks.

Los Aguages derives its name from a series of tanks located in the bedrock bottom of the wash. The main ruins are located in the proximity of the largest of these tanks which includes a very large well-like reservoir located some 50 m west-northwest of Provenience No. 2. This feature was named "El Cenote"; it was found to contain water even following considerable dry periods. The nature of the Anasazi elaboration of this well and the tanks above it is not known due to silt fill. However, it is conceivable that a considerable reservoir could have been created downstream from the well and that the holding capacity of the upper tanks was enlarged. A substantial amount of surface water can be found in the tanks at almost any time of year, suggesting a steady supply of domestic water within easy reach of Penasco Blanco. Los Aguages is certainly situated in order to facilitate exploitation of the surface water.

Los Aguages consists of the reduced remains of three masonry structures located on slickrock benches flanking Arroyo de Los Aguages, heretofore unnamed lateral of Ahshislepah Canyon. The structural aspects of the ruin are concentrated on the eastern margin of the wash and flank the projected centerline of the prehistoric road. Here the road leaves the mesa top and drops onto the slickrock about 100 m south-southeast of the ruin. Modification of the slickrock where the projected road drops into the site area was not positively identified, although "suspicious" features were noted. Structurally, the Los Aguages ruin itself consists of two enclosures of moderate dimensions, constructed of rubble core-and-veneer masonry in the Bonito Style.

Provenience No. 1 is the southernmost of the compounds and consists of two actual enclosures. One is situated about 1 m above the other on a higher sandstone slickrock ledge. The relationship between the two enclosures suggests that the two features form a possible "gate" across the prehistoric alignment. Provenience No. 2 is situated 23 m north and slightly above Provenience No. 1, on the same slickrock bench. Provenience No. 2 is primarily a single enclosure. Rubble suggests masonry terraces which may define and flank the road.
Provenience No. 1: Feature No. 1: Scattered rubble indicates an "L"-shaped wall which is non-contiguous with Feature No. 2 but apparently forms an enclosure of approximately 8 x 12 m. Alignments in Feature No. 1 are poorly visible and in an advanced state of reduction. Type of masonry is not known although rubble-core would be consistent with construction on the remainder of the site. Maximum original height probably did not exceed 1 m. Fill within the structure is primarily blow sand and appears to be approximately .5 m in depth.
Provenience No. 1: Feature No. 2: This feature consists of an irregular multi-sided enclosure or compound 9 x 7 m in interior dimensions. The structure may have been open to the south; however, advanced reduction precludes identification of the exact configuration. Wall alignments are partially visible however, and walls of rubble-core construction .65 m in thickness are apparent. Mound relief of the structure is approximately 1 m. Maximum standing wall height is estimated to have been 1.5 to 2 m and walls may have formed an enclosure which was unroofed. Construction is of dense, angular dark brown sandstone slabs which occur locally. Elements range from spalls to large irregular blocks; average dimensions of the elements are .30 x .30 x .05 m. A natural ledge is incorporated into the structure. Some burned elements are present.



Provenience No. 2: This provenience consists of a masonry structure with massive rubble-core walls .75 m in thickness. These walls are still partially standing on the north and east sides of the structure; a trace of rubble suggests the presence of the south and west walls. The structure appears to be roughly square with interior dimensions of 3.5 x 4 m. It is located 23 m north of and slightly higher than Provenience No. 1, Feature No. 2, but on the same sandstone

slickrock bench. Maximum standing wall height is 1.5 m. Massive slabs incorporated into the wall matrix range up to .60 x .30 x .10 m. This is obviously the most massive of the structures at Los Aguages. Downslope to the south and west of this structure is a considerable amount of rubble which suggests an artificial terrace flanking the prehistoric road. Depth of fill in this area is unknown.

Provenience No. 3: Provenience No. 3 consists of a surficial scatter of masonry found on the slickrock west of Arroyo de los Aguages, 42 m south-southwest of Provenience No. 1, Feature No. 1. Dimensions of the scatter measure roughly 5 x 12 m. Depth of the feature is very shallow and probably does not exceed .20 m. Fill is sandy on the northern end of the feature and non-existent on the southern end. Burned sandstone elements are present. From a distance the feature appears to be a masonry staircase; however, not enough rubble is present to justify this conclusion. The actual use of the feature is not known, but it may have functioned as a retaining wall.

Provenience No. 4: This provenience consists of a shallow storage feature roughly 2 m in length constructed into a concavity in a bedrock ledge immediately northeast of Provenience No. 2. The concavity is walled off with several courses of dry stacked sandstone. The character of construction suggests that it is historic in origin.

Provenience No. 5: This provenience consists of a series of 3 steps pecked into the slickrock immediately above a tank in the arroyo bottom roughly 35 m west of the structures. The steps are elongated and together form a rough triangle. Apparently they were intended to form a base or "platform" adjacent to the tank. They are in excellent condition and have weathered only slightly; peck marks are still quite apparent.

Midden Deposition: No formal midden deposition was noted in the vicinity of the structures. However a surface scatter of ceramics appeared to correspond with the alignment of the Penasco Blanco to Ahshislepah Road as it traversed the slickrock, which was more concentrated in the vicinity of the Los Aguages structures.

Material Culture: Ceramic material was present but not abundant. The sample represents a tally of approximately 75% of the material in the site area.

	Jar	Bowl	Indeterminate
Cibola Grey Ware			
Plain	5		12
Corrugated Indented	25		
Cibola White Ware			
Undifferentiated	20	1	21
Escavada B/W	1	1	
Gallup B/W	16	3	1
Chaco B/W	6		
Mesa Verde White Ware			
Undiagnostic	2	1	1
McElmo B/W	5	6	1
Chuska Grey Ware			
Corrugated Indented	1		
White Mountain Red Ware			
Undiagnostic			1

Transect Samples: A series of transects 400 m x 50 m were centered on Los Aguages parallel with the slickrock shelf. The width of the first transect roughly corresponded to the width of the shelf. Parallel transects of the same dimension were documented on the mesa top above the shelf. In all, 6 transects were recorded. Results of the transect documentation suggest that in fact ceramic density was considerably higher on the slickrock shelf where it overlapped with the imaged road alignment.

Transect No. 1: This transect extended along the slickrock bench to 400 m south of Los Aguages. A concentration of material was found in the area where the road alignment intersected the bench.

	Jar	Bowl	Undifferentiated
Cibola Grey Ware			
Corrugated Indented	2		
Plain	2		
Cibola White Ware			
Undiagnostic	4		
Escavada B/W		2	
Gallup B/W	5		
Mesa Verde White Ware			
McElmo B/W		1	

Transect No. 2: This transect extended from Los Aguages 400 m to the northwest along the slickrock bench terminating at a fenceline and bounded by the edge of the mesa cap. Average width was 50 m. The entire length of this transect overlapped with the projected alignment of the prehistoric road.

	Jar	Bowl	Undifferentiated
Cibola Grey Ware			
Plain	9		3
Banded	4		
Corrugated Indented	17		
Cibola White Ware			
Undiagnostic	9	3	1
Red Mesa B/W	1		
Gallup B/W	5	4	
Mesa Verde White Ware			
Undiagnostic	4	1	
McElmo B/W	4	3	
White Mountain Red Ware			
Undiagnostic			1
Sanostee Red-on-Orange	1		

Transect No. 3: Transect No. 3 extended 400 m north of the fence where Transect No. 2 terminated. Again, this transect corresponded with the width of the slickrock shelf which is approximately 50 m, and followed the projected alignment of the prehistoric road.

	Jar	Bowl	Undifferentiated
Cibola Grey Ware			
Plain	10	2	11
Banded	3		
Corrugated Indented	5		
Cibola White Ware			
Undiagnostic	27	2	
Red Mesa B/W		1	
Escavada B/W	3		
Gallup B/W	4	4	
Mesa Verde White Ware			
Undiagnostic	9	3	
McElmo B/W	6	9	
Chuska Grey Ware			
Plain	1		
Corrugated Indented	5		
Chuska White Ware			
Undiagnostic	2		
Red Mesa Style	1		
Solid Style	1		
White Mountain Red Ware			
Puerco B/R	1		
Socorro B/W	2		
Navajo Utility Ware	14		

Transect No. 4: This transect paralleled Transect No. 3 but was situated on the sandy mesa cap above the slickrock shelf. The fact that this transect did not correspond to the imaged alignment of the prehistoric roadway is reflected in the low density of ceramic material.

Cibola White Ware			
Undiagnostic	1		
Gallup B/W	1	1	

Transect No. 5: This transect was situated on the sandy mesa cap parallel to Transect No. 2. Again this transect was not located within the imaged alignment of the prehistoric road, which is reflected in the low density of ceramic material.

Cibola White Ware			
Chaco B/W		1	
Mesa Verde White Ware			
Undiagnostic	1		

Transect No. 6: This transect originated above Los Aguages and extends 400 m southward parallel to Transect No. 1. Transect width was 50 m. It corresponded with the margin of the sandy cap of the mesa. Portions of this transect overlap with the prehistoric alignment.

Mesa Verde White Ware			
Undiagnostic	1		
Mesa Verde B/W	1		

Material Culture: Lithics

Los Aguages vicinity: talley of site area

Petrified Wood	2

Transect No. 1

Petrified Wood	8
Brushy Basin Chert	1
Washington Pass Chert	1

Transect No. 2

Petrified Wood	2
Petrified Wood	1 (Core)
Pedernal-like Chalcedony	1
Clear Chalcedony	1 (Projectile Point)

Transect No. 3

Petrified Wood	9 (1 core)
Pedernal-like Chalcedony	5
Miscellaneous Chalcedony	5
Quartzite	4
Butterscotch Chert	1
Miscellaneous Chert	1 (1 core)

Transect No. 4

Petrified Wood	4
Pedernal-like Chalcedony	1 (1 core)
Miscellaneous Chalcedony	5
Quartzite	1
White Chert	1 (1 core)
Fire-reddened Sandstone	3

Transect No. 5

Miscellaneous Chalcedony	1
White Chert	1

Transect No. 6

Petrified Wood	2

Ground Stone: Ground stone artifacts noted consisted of one one-hand biscuit type mano on Transect No. 3.

Material Culture: Historic

Los Aguages Vicinity: A turn-of-the-century wagon road is still visible entering the site area from the west crossing Arroyo de los Aguages and continuing eastward. Walking approximately 500 m of this road to the west revealed a rivet from a harness and an iron barrel hoop, presumably from a water barrel. To the east within the corridor (200 m) a fragment of a wagon spring and a tin suitcase were found. Curiously there is very little evidence of historic modification or use of the area. Scraps of clear glass from jugs, several old shoes, fragments of enamelware cooking utensils, a pair of socks and a trace of purpled glass were noted in the site area.

Transect No. 1: Iron hoop from water barrel
5-gallon tin bucket
lid from 15-gallon barrel
All steel church-key-opened pop can
44 caliber WCF cartridge

Transect No. 2: No historic material noted

Transect No. 3: 303 style crimpled seam vegetable type can
Crimped seam can lid
Crimped seam coffee can
2 clear glass soda bottles, no deposit no return
9 fragments of aqua glass from turn-of-the-century bottle

Transect No. 4: Shasta pop-top can

Transect No. 5: No historic material noted

Transect No. 6: 1 fragment of a wagon spring
1 sheep rattle made from crimped seam coffee can

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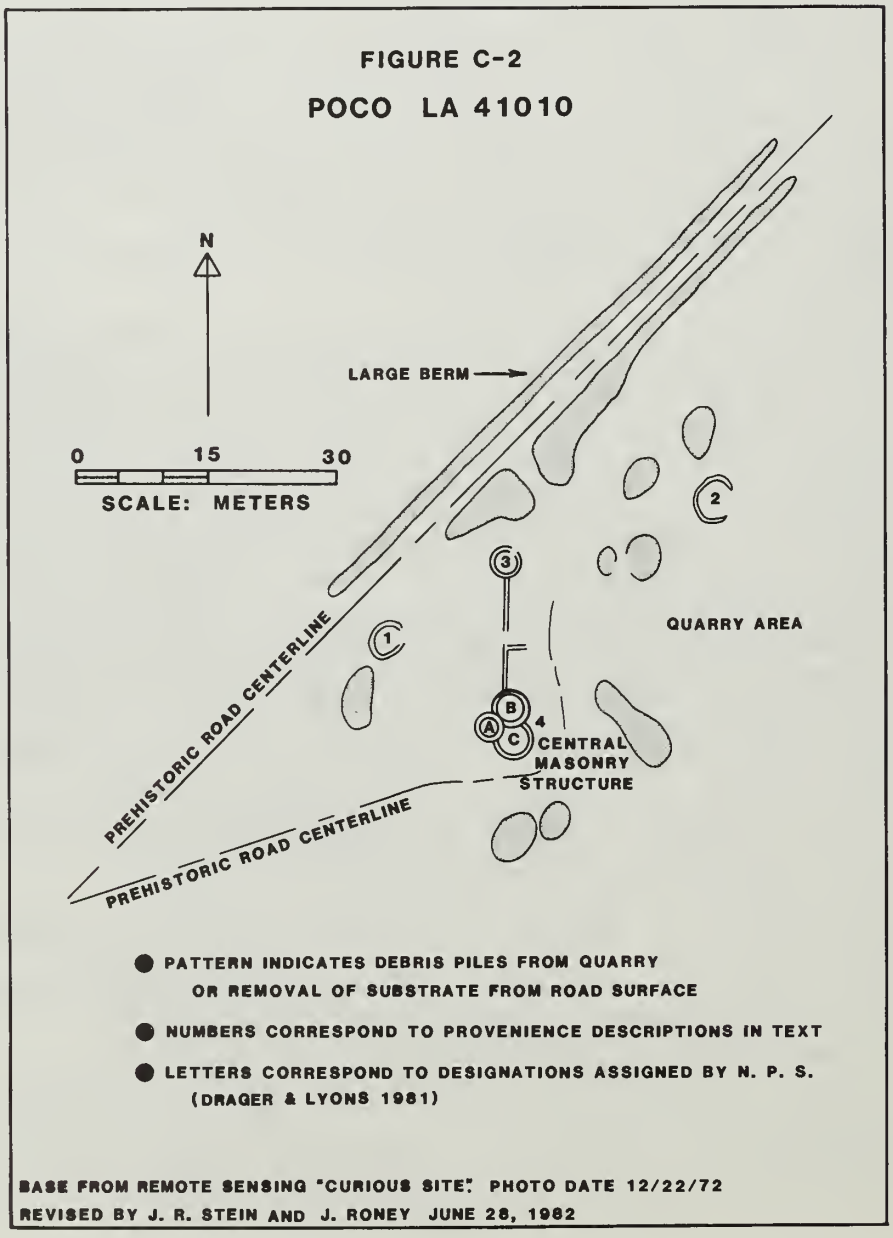
Site Name: "Curious" or Poco Site
LA Number: 41010
Other Numbers: Chaco Center Survey Number: 29 SJ 1010
References: Drager and Lyons (1976)
Recorder: John R. Stein and John Roney (June, 1982)
Temporal Affinity: An archaeomagnetic date of 1210 ± 11 years was obtained from a firepit in Circle A. The disparity between archaeomagnetic and tree ring dates suggests that this structure was constructed and utilized in the 1130s AD (Windes 1982: personal communication).
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Chetro Ketl to Escavada Complex Road (recorded by the Remote Sensing Project as the "Sandspit Road")
Topographic Situation: The site area is situated on a high mesa separating the Escavada and Chaco drainages. Distance from the site to Chetro Ketl is approximately 3.4 km. Distance to the Escavada Complex is approximately 2.4 km. North of the structures the terrain drops sharply into the Escavada Valley (see Figure 4-1).
Visible Horizon: The Poco Site rests in a slight hollow in the mesa top which limits visibility to the south. However, one has a panoramic view of the Escavada drainage to the north; distant landmarks such as the Chuska Mountains, White Rock and Huerfano Mountain are visible on the far horizon. Pueblo Alto, Penasco Blanco and Bis'a'ani are also visible from this location. Feature No. 5 is located 140 m and 145 degrees from the "Central Masonry Structure" (see Figure 9-8). From this location, which is atop the highest point of the mesa, the southern skyline comes into clear view with Fajada Butte, Fajada Gap, Shrine 29 SJ 706 and several Bonito Style structures above Mockingbird Canyon clearly visible. Richard Loose (1982: personal communication) recalls that the eastern horizon from the Poco location is "true" suggesting that accurate solstice observations could have been made here.
Soil Structure: Shallow sandy loam mantle over sandstone substrate
Vegetation: Grasses, saltbush, sagebush, yucca, snakeweed
Primary Drainage: Escavada Wash, Chaco Wash
Elevation: 6530'
Site Description: The Poco Site consists of a constructed portion of the prehistoric roadway connecting Chetro Ketl with the Escavada Complex (see Figures 9-8 and C-2). In association with this formalized segment of roadway are 6 circular or semi-circular enclosures ranging from 6 to 8 m in diameter. In addition a circular slab-lined firebox 2 m in diameter (Feature No. 5) may represent a signalling location. A very large area (150 x 150 m) east of the Central Masonry Structure shows evidence of extensive prehistoric quarrying activity. This quarry effectively pedestals the Central Masonry Structure and accounts for numerous large mounds of detritus. Much of the spall and overburden material from the quarrying operation was heaped alongside the road alignment to form massive berms up to 10 m in width and 1 m in relief. It appears that the road surface itself may have served as a quarry. As the structures within the Poco complex are modest in proportions the stone quarries here were more likely utilized in the construction either of great houses within Chaco Canyon proper or the structures in the area known as Chaco North.
Feature No. 1: This feature is an Herradura-like structure 6 m in diameter. A formal opening is oriented at approximately 60 degrees. Construction is of sandstone slabs and blocks averaging .50 x .35 x .05 m in size. These elements are laid into the walls in a compound fashion. Mound relief is currently .75 m suggesting that the wall height never exceeded 1 m.
Feature No. 2: This feature is a circular or semi-circular structure similar to Feature No. 1. This structure is located on the extreme eastern margin of the mesa east of the Central Masonry Structure. It is in an advanced state of reduction and portions of the walls appear to have been washed away. The remaining structural fabric shows the feature to be 7 m in diameter with very low walls, probably less than .5 m high originally. Large slabs were utilized in construction and were likely laid up to form a compound wall. Vertical slabs may also have been used in part to define the structure.
Feature No. 3: Feature No. 3 is again a circular structure 6 m in diameter and opening approximately true north. This structure is articulated with the Central Masonry Structure via a massive rubble-core wall. Although wall height of this structure is consistent with that described for Feature Nos. 1 and 2, construction is more massive in nature.
Feature No. 4: This feature consists of 3 contiguous circular masonry structures referred to as the Central Masonry Structure by Drager and Lyons (1976). The following description is based on the excavation report of this structure (Drager and Lyons 1976).
The overall dimensions of Circles A-C (see Figure 9-8) are approximately 15 x 15 m. Circle A is 6 m in diameter while Circles B and C are 8 m in interior dimensions. Excavation of Circle A revealed a use level immediately beneath the present surface as evidenced by the presence of 4 burned areas. The fill beneath this level appeared to have been intentional and the original floor level was encountered .45 m below the present ground surface. The floor level contained a large open hearth which was sampled for archaeomagnetic dates. Aside from this hearth a small sealed niche in the southeast portion of the wall was the only other

interior feature. Excavation of Circles B and C uncovered an additional large firepit in Circle B but only scattered burned areas in Circle C. The floors of these structures were apparently plastered. The map (Figure 9-8) illustrates a narrow entry between Circles B and C. A platform 1.75 x 1.50 m and .2 m in height rested on the floor of Circle C abutting the common wall with Circle A. Although this raised feature was outlined with coursed masonry, the center consisted of sterile sand fill.

A massive masonry wall connects the Central Masonry Structure with Feature No. 3. Approximately midway between the structures is a gate or opening in the wall. Height of the wall is consistent with the low relief of the circular structures.



Feature No. 5: Feature No. 5 consists of a slab-lined circular firebox 2 m in diameter. This feature is located on the highest point of the mesa 140 m and 145 degrees from the Central Masonry Structure. This feature has much more effective visibility than does the main site area and shows evidence for repeated large fires, suggesting signalling as a probable function. Ash and burned debris are scattered within a zone extending 5 m from the hearth. Ceramic material is absent from the site area; however, numerous small pressure flakes were noted.

Masonry: Walls were constructed of massive compound to rubble-core masonry. They range to 1 m in thickness, and utilize coursed tabular sandstone elements. Maximum wall height probably never exceeded .5 m. Walls were constructed on a shallow prepared clay footing probably excavated somewhat into the existing substrate. Richard Loose (1982: personal communication) has commented that the wall construction at Poco is virtually identical to that of the extensive walls at Pueblo Alto.

Middens: No formal middens were documented in the vicinity of the Poco structures. Material culture in the site area was extremely sparse.

Material Culture: Ceramics

(Vessel form was not recorded.)

Cibola Grey Ware	
Plain	2
Corrugated	12
Cibola White Ware	
Undiagnostic	12
Red Mesa B/W	2
Escavada (solid style)	12
Gallup B/W	10
Chaco B/W	4
Mesa Verde White Ware	
Chaco McElmo	1
Chuska White Ware	
Nava B/W	1
Chuska Utility	
Corrugated	2
White Mountain Red Ware	
Undiagnostic	1
Puerco B/R	1
Other	
Smudged Red Ware	2
Black Mesa B/W	1
TOTAL:	63

NOTE: Sample is total for surface and excavated material. Undiagnostic White Wares are classified as Cibola, Puerco and Escavada styles are classified as Escavada, and Chaco-McElmo is classified as Mesa Verde White Ware to make the sample more consistent with categories utilized for the Chaco Roads Project.

Articulation with the Roadway: The structures at Poco Site do not seem to be physically articulated with the road surface. These structures are certainly road-related, however, their location no doubt is conditioned by the presence of the road. A "spur" connects the Central Masonry Structure with the main Chetro Ketl to Escavada Complex roadway.

Summary: The Poco Site was the focus of research conducted by the Chaco Center, Remote Sensing, Project, National Park Service during the summers of 1975 and 1976. Results of these excavations are presented in Drager and Lyons (1976) and summarized in this description. The additional information presented herein is derived from a ground check of the large-scale aerial map of the site area flown by Remote Sensing in July of 1973. This ground check was performed by John R. Stein and John Roney in June, 1982.

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Site Name: Pierre's Ruin, The Acropolis, Unit C

LA Number: 35423

Other Numbers: Chaco Center Survey Number: Pierre's Ruin C

Recorder: William Kight, Richard W. Loose, John R. Stein, Daisy F. Levine

Temporal Affinity: This site dates to the late eleventh and early twelfth centuries, based on tree ring specimens collected from Unit B by Powers (Powers, Gillespie and Lekson 1983) and ceramic associations. (Marshall: 1080-1125 AD)

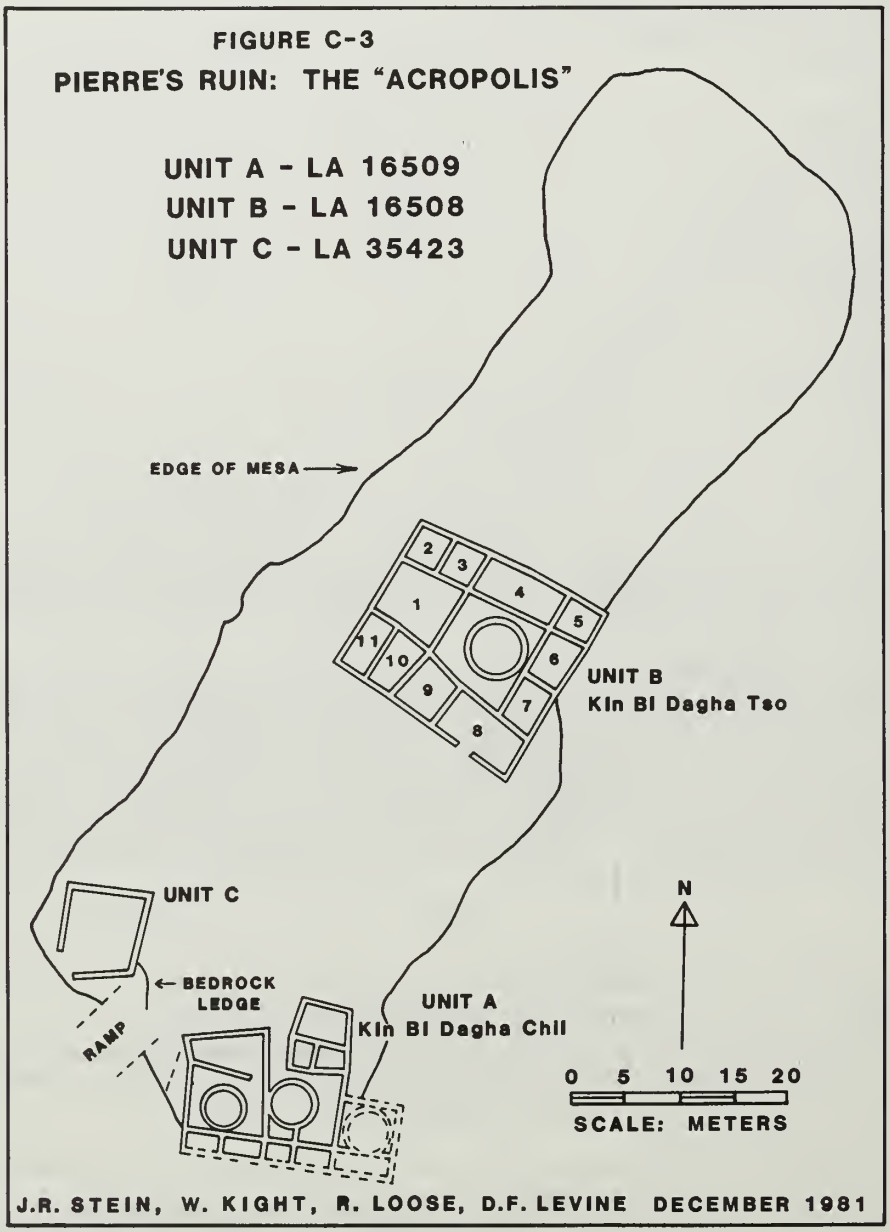
Cultural Affinity: Eastern Anasazi, Chaco Expression

Road Association: North Road

Topographic Situation: Structure C is situated on the southwestern margin of the Acropolis mesa 7 m distant to the west from Kin Bi Dagha Chii.

Visible Horizon: Visibility from this point on the summit of the mesita was likely not a direct consideration in its construction and is generally confined to the north and west. For a discussion of visibility from this vantage point refer to description of (LA 16509) Kin Bi Dagha Chii.

Soil Structure: Bedrock
Vegetation: Grasses, sage, shadscale in vicinity
Land Status: Bureau of Land Management
Primary Drainage: Unnamed lateral to Coal Creek
Elevation: 6500'
Site Description: Unit C consists of single large masonry room measuring 6.5 x 7.5 m in maximum interior dimensions (see Figure C-3). The room is sub-rectangular in shape with the southern wall deviating from true square to form a doorway or gate roughly 2 m in width, which opens to the west on the southwest corner of the structure. Mound relief is approximately .75 m and the presence of rubble suggests walls approaching full height.
Masonry: Construction of Unit C was accomplished via masonry elements consistent with those described for LA 16508-9. Wall alignments are visible and of rubble-core construction averaging .5 m in thickness.



Plaza: Unit C forms the southwestern definition of the plaza surface.
Associated Middens: Unit C does not appear to be directly associated with documented midden deposition.
Articulation with the Roadway: Unit C is directly articulated with the spur of the North Road referred to as the ramp. Along with the southwestern corner of Kin Bi Dagha Chii, Unit C forms a formalized entrance to the plaza summit of the Acropolis mesita.
Comments: Unit C is a type of Bonito Style structure commonly found in association with roads. Its placement adjacent to a great house is reminiscent of the arc-shaped shrine at Skunk Springs.

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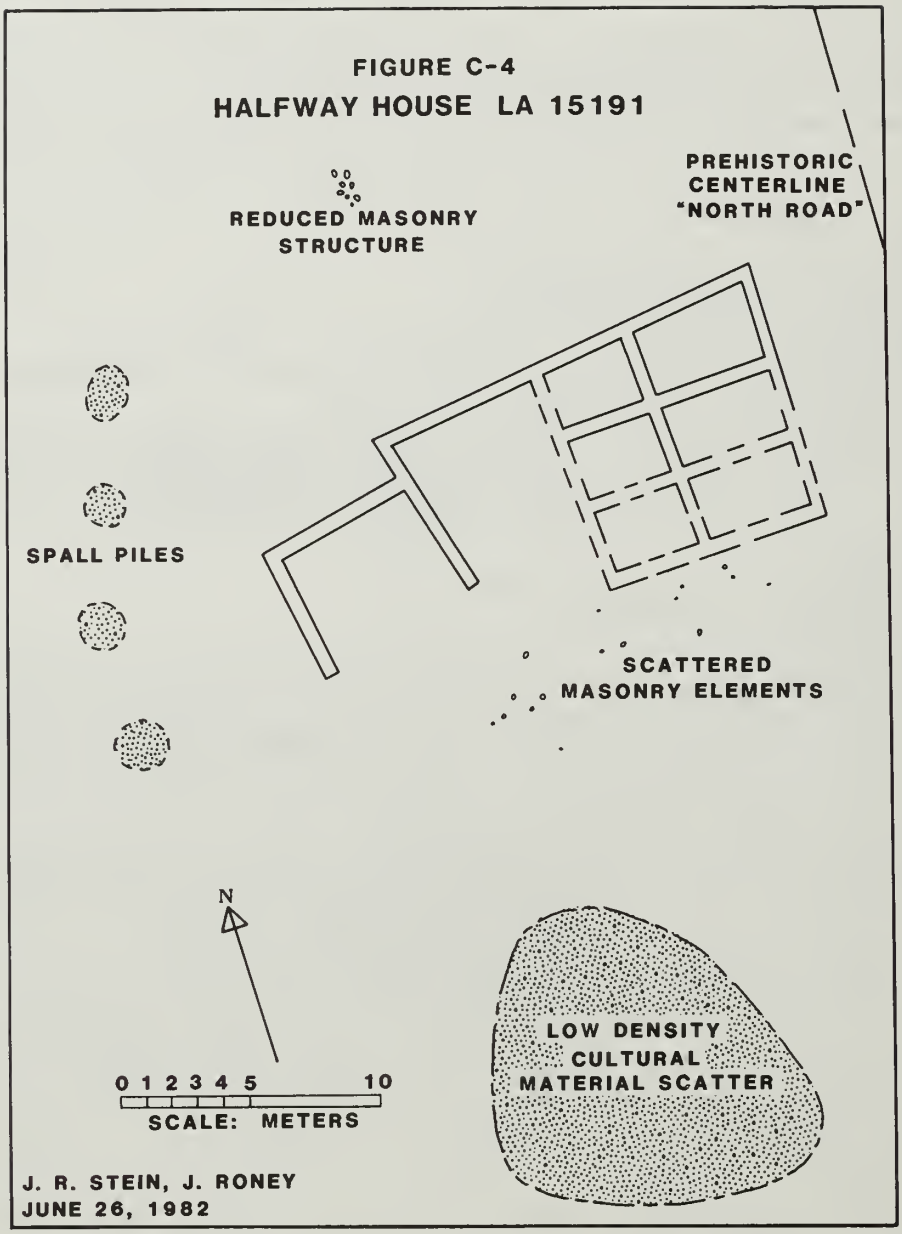
Site Name: Halfway House
LA Number: 15191
Recorder: John R. Stein, John Roney (June, 1982)
References: Powers, Gillespie and Lekson 1983
Temporal Affinity: Marshall: 1000-1125 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: The structure is situated on the southern margin of a prominent ridge west of and overlooking an unnamed lateral to Gallegos Wash.
Visible Horizon: The structure is elevated in a landscape characterized by rolling sage plano and exposed badland formations. A long badland ridge characterizes the middle horizon to the west with the Chuska Mountains on the far horizon. Huerfano Mountain, the La Plata Mountains and Angel Peak are visible to the north. It is not known whether other features on the North Road such as Gallegos Crossing (LA 34303) or Burned Jacal (LA 34304) are visible from this location.
Soil Structure: Sand
Vegetation: Sage, snakeweed, grasses, juniper, pinyon
Land Status: Bureau of Land Management
Primary Drainage: Gallegos Wash
Elevation: 6600'
Site Description: Halfway House is a structure constructed in the Bonito architectural style but lacking an enclosed kiva (see Figure C-4). Six contiguous masonry rooms and 2 small enclosures are contained in a building measuring 10 x 22 m. The North Road may articulate with the structure along its eastern wall. The structure appears to be oriented to the south and does not, therefore, open onto the road. Mound relief is difficult to estimate because the structure is perched upon a slight natural elevation, however it appears to be about 1 m. A single story structure is represented.
Masonry: Wall alignments within the structure are generally poorly visible and portions of the southern margin of the structure may have been removed by erosion. Wall thickness cannot be accurately measured, however mass of the masonry suggests that the walls were of compound to rubble-core construction. Masonry elements consist of unshaped irregular to angular blocks and slabs of a friable coarse-grained sandstone which does not occur in the immediate vicinity of the ruin. Size of the masonry elements averages .3 x .3 x .05 m.
Kivas: No kivas are apparent from surface observations at Halfway House. Certainly no kivas of the housed or blocked-in type are incorporated into the roomblock. It is very unlikely that any fully subterranean kivas are located on the erosional slope south of the structure.
Middens: A surficial scatter of cultural material, 12 x 14 m in extent is located 12 m downslope and south of the structure. Material density is very low and the sandy soil is somewhat ashy and intermixed with occasional masonry spalls. The midden represents a slight concentration of material culture and construction debris in an otherwise low density scatter of material culture in the ruin vicinity.
Construction Middens: Four concentrations of spalls, each shallow and 2 x 2 m in diameter probably represent construction waste. These middens are located 6 m east and northeast of the structure.
Other Features: A concentration of slabs in a 2 x 2 m area 9 m north of the rear wall of the structure may represent an exterior feature of unknown form and function.
Material Culture: Ceramics
Total observed from midden surface, road vicinity and house mound:

	Midden	House Mound	Road	Total
Cibola Grey Ware				
Plain	1			1
Corrugated Indented	35	3	16	54
Cibola White Ware				
Undifferentiated	11		3	14
Gallup B/W	3			3
Escavada B/W	2	1	1	4
Chaco B/W			2	2
Chaco Painted White Wares				
McElmo	3	6	6	15



	Midden	House Mound	Road	Total
Chuska Grey Wares				
Chuska Corrugated	2		2	4
Bowls	8	3	4	15
Jars	46	6	24	76
Indeterminate	1	1	2	4
TOTAL:				192

Material Culture: Lithics				
Rhyolite	1			1
Petrified Wood	5+	1	3	9
Quartzite			1	1
Butterscotch Wood	1			1
Red Dog Shale	3			3
Unknown	1			1
Miscellaneous Chalcedony		1		1
Jemez Obsidian			1 (spoke shave)	1
Hammerstones				
Petrified Wood	1			1
Quartzite	1	1		2
Fire-Cracked Quartzite	1		1	2
Projectile Points				
Chalcedony		1		1
Ground Stone				
Undifferentiated			1	1
One-hand Mano			1	1
Scraper				
Petrified Wood			1	1
Fragment of Shell Bracelet		1		1
TOTAL:				28

Articulation with the Roadway: Halfway House appears to be adjacent to but not necessarily articulated with the North Road. As the road alignment approaches the structure from the north a distinct swale is visible for approximately 100 m on a bearing of 0 (zero) degrees (true north). The swale becomes broader and deeper as it nears the ruin. A cross section measured 32 m north of the structure shows a swale 12 m in width and .7 m deep. The swale becomes indistinct and is not ground-visible to the south of the structure.
Site Condition: Portions of this ruin have been disturbed either by treasure hunters or by unknown archaeologists. Wall alignments on the eastern margin of the structure were exposed some time during the last decade; in addition a pit 1 x 3 x .65 m in the central eastern room was recently excavated and not backfilled. In all, 4 of the 6 possible rooms within the block and the surface of both "courts" show evidence of disturbance.
At the time of this documentation effort (June 26, 1982) an attempt was made to backfill the open pit in the central eastern room. The stratigraphy in the pit consisted of two layers of material. From the surface to .45 m was a sterile overburden intermixed with wall fall. From .45 m to .65 m was an ashy layer mixed with charcoal and lenses of oxidized soil and adobe. This layer produced carbonized bone and cultural material.
When backfilling the pit, a layer of material (bottles and cans) was gathered from the site vicinity and deposited in the pit floor. Excavated fill had been thrown in piles on the north and south margins of the pit. The material to the north was primarily the sterile overburden, and that to the south primarily the cultural layer. The overburden was screened through a 1/8 inch screen into the pit revealing no cultural material. The ash material still piled to the south of the pit was left and should be collected in the near future.
Summary: Halfway House is a small masonry structure which like other features along the North Road dates to late in the Chaco sequence. Halfway House is the third most substantial structure known on the road after the Pierre's Complex and Kin Indian Ruin. Although similar in some respects to Kin Indian Ruin, Halfway House lacks an enclosed kiva incorporated into the roomblock, and is otherwise less substantial than that structure. The location of Halfway House with respect to the North Road and its elevated topographic position certainly argue that it is a road-related feature, although it should probably not be considered a great house *per se*. Fragments of burned adobe on the surface of this ruin and the material within the pit suggest that this structure may have burned.

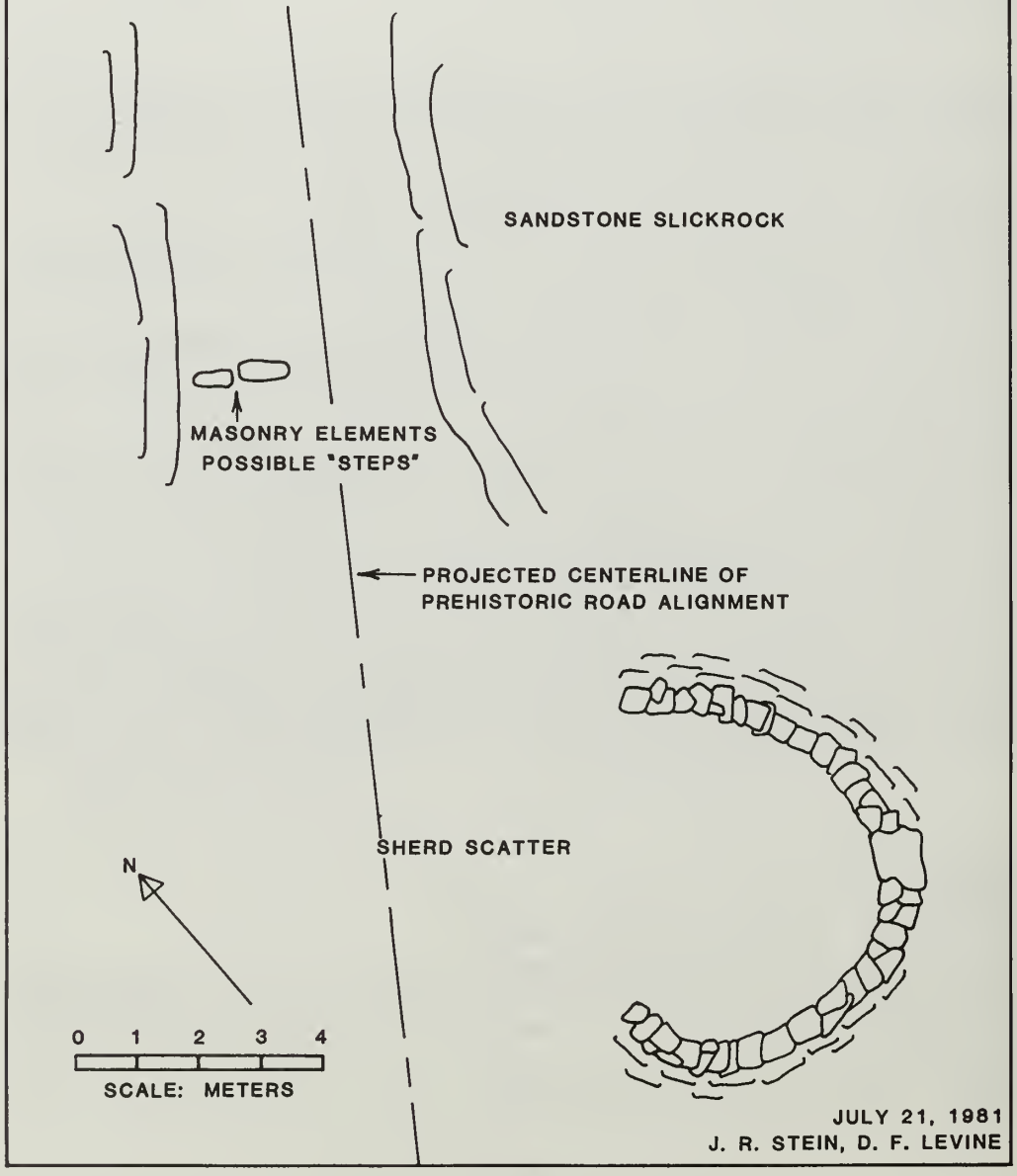
★

Site Name: Yellow Point Herradura
LA Number: 35417
Other Numbers: Chaco Center Survey Number: 29 SJ 2241
Temporal Affinity: Marshall: 1000-1125 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: South Gap to Kin Bineola Road
Topographic Situation: The site is situated in an elevated situation above the Yellow Point Valley, on the northwestern margin of a low mesa.
Visible Horizon: Yellow Point Valley to the west, and Kin Klizhin and South Gap to the northeast.
Soil Structure: Sandy loam
Vegetation: Grasses, snakeweed, ephedra, prickly pear cactus, sage and saltbush
Drainage: Unnamed lateral to the Kimmeneoli Wash

Elevation: 6260'
Site Description: Site consists of a "C"- or "D"-shaped masonry room 4 x 5 m in interior dimension (see Figure C-5). Structural remains are reduced to walls .4 m in relief composed of angular dense dark brown sandstone elements averaging .3 x .2 x .1 m in size. Masonry was likely of compound construction and incorporated native bedrock elements into the wall matrix. The amount of rubble suggests that the walls once stood approximately 1 m in height. Sandy fill within the structure is probably .3 m in depth. The structure is oriented roughly to the southeast and opens onto the projected prehistoric alignment. Immediately south of the structure, the road apparently drops into a 5 m wide gap in the mesa edge which slopes downward at approxi-

FIGURE C-5

YELLOW POINT HERRADURA LA 35417



mately 10 degrees. Scattered masonry and ceramics within this feature suggest that it may have once contained steps or that it was otherwise formalized. The alignment at this point follows a bearing of 205 degrees.
Associated Middens: No formal deposition was noted in association with this structure. A slight scatter of ceramic material is evident in the immediate vicinity of the structure including a limited area below the "ramp."
Material Culture: Ceramics

	Jar	Bowl	Indeterminate
Cibola Plainware	3		
Cibola Banded	1		
Cibola Corrugated	3	1	
Undiagnostic Cibola White Ware	8	2	
Red Mesa B/W	1		
Gallup B/W	5		
McElmo B/W	2	2	

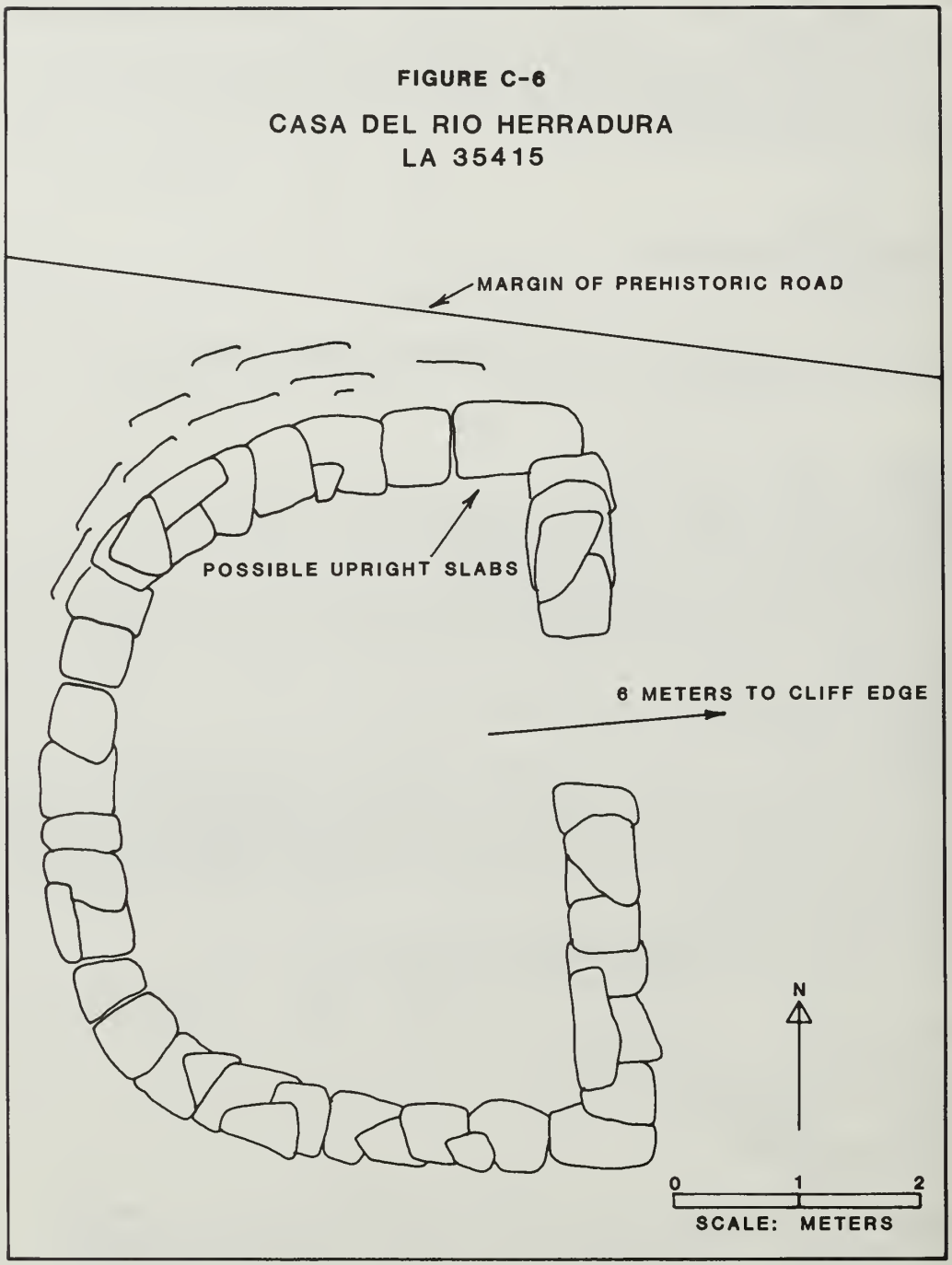
Articulation with the Roadway: The structure appears to be directly articulated with the South Gap to Kin Bineola Road; it is oriented so as to open onto the road alignment.

★

Site Name: Casa del Rio Herradura
LA Number: 35415
References: Michael Marshall (1982: personal communication
Temporal Affinity: Marshall: 1050-1125 AD; Weighted Ceramic: 967-1159 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Casa del Rio to Lake Valley Road
Topographic Situation: This structure rests on the eastern margin of a high mesa overlooking the Chaco Wash which is 2 km distant to the east and 80 m below. Tse Ka'a towers above the structure 600 m to the northeast and the ruin of Casa del Rio lies 700 m to the east.
Visible Horizon: The structure is situated so as to command a clear view of the mouth of Chaco Canyon.
Soil Structure: Sandy loam
Vegetation: Grasses, sandsage, yucca, snakeweed
Drainage: Chaco Wash
Elevation: 6200'
Site Description: Site consists of a "D"-shaped structure 5 x 3.5 m in interior dimensions (see Figure C-6). Walls are reduced to low mounds .5 m in relief. Masonry elements range from .2 to .4 m in size and are generally tabular slabs of dense dark brown sandstone of local derivation. Although the remains of a historic fence exist in the site area, the advanced state of reduction, presence of Anasazi materials and lack of other historic materials strongly suggest Anasazi affiliation. The structure is oriented roughly east. There appears to be a formal opening 1.5 m in width in the eastern wall.
Material Culture: Ceramics
Only a slight scatter of ceramic material is associated with the structure.
Sample is total for site area.

	Jars	Bowls	Indeterminate
Cibola White Ware			
Undifferentiated	5		
Escavada B/W		2	
Gallup B/w	3		
Carbon Paint White Wares			
McElmo	1		
White Mountain Red Ware			
Wingate B/R		1	

Articulation with the Roadway: This structure is slightly elevated above and immediately south of a slight swale which represents the alignment of the prehistoric Casa del Rio to Lake Valley Road. The orientation of the structure is almost perpendicular with the projected prehistoric alignment, with the doorway facing the access up the steep slope of the mesa. No formal evidence of the road is apparent on the slope.
Bifurcation: Immediately to the west of this structure the prehistoric alignment appears to bifurcate, with one alignment continuing on a bearing of 280 degrees and the other branching along a bearing of 310 degrees. This bifurcation is clearly illustrated in aerial photographs flown by the Remote Sensing Division, Southwest Cultural Resources Center, National Park Service (see Figure 9-9). This is one of a very few locations where the bifurcation of a prehistoric alignment is visible on the ground.
The West Branch: The west branch is visible on the ground as a linear swale for approximately 300 m at a bearing of 280 degrees. Alluviation is more pronounced here and the segment is



somewhat less distinct than on the northwest branch. The characteristic scatter of sherds is obscured on this segment.

The Northwest Branch: Bearing 310 degrees, this branch of the road is clearly visible as a linear swale for approximately 400 m. A dense scatter of ceramics is associated with the swale.

Material Culture: Ceramics

(Northwest Branch Grab Sample (to 100 m from bifurcation)

	Jars	Bowls	Indeterminate
Cibola Grey Ware			
Plain			10
Corrugated	1		
Cibola White Ware			
Undifferentiated	13	5	
Gallup B/W	9	1	
Escavada B/W	1		
Red Mesa B/W	6	2	
Carbon-Painted Wares			
McElmo B/W		1	
Mesa Verde-McElmo			1
Chuska Grey Ware			
Banded	7		
Plain	3		
Corrugated	3		
Chuska White Ware			
Undifferentiated			7
Unidentified White Ware	3	1	
White Mountain Red Ware			
Puerco		6	
Material Culture: Lithics			
Pedernal-like Chalcedony	1		

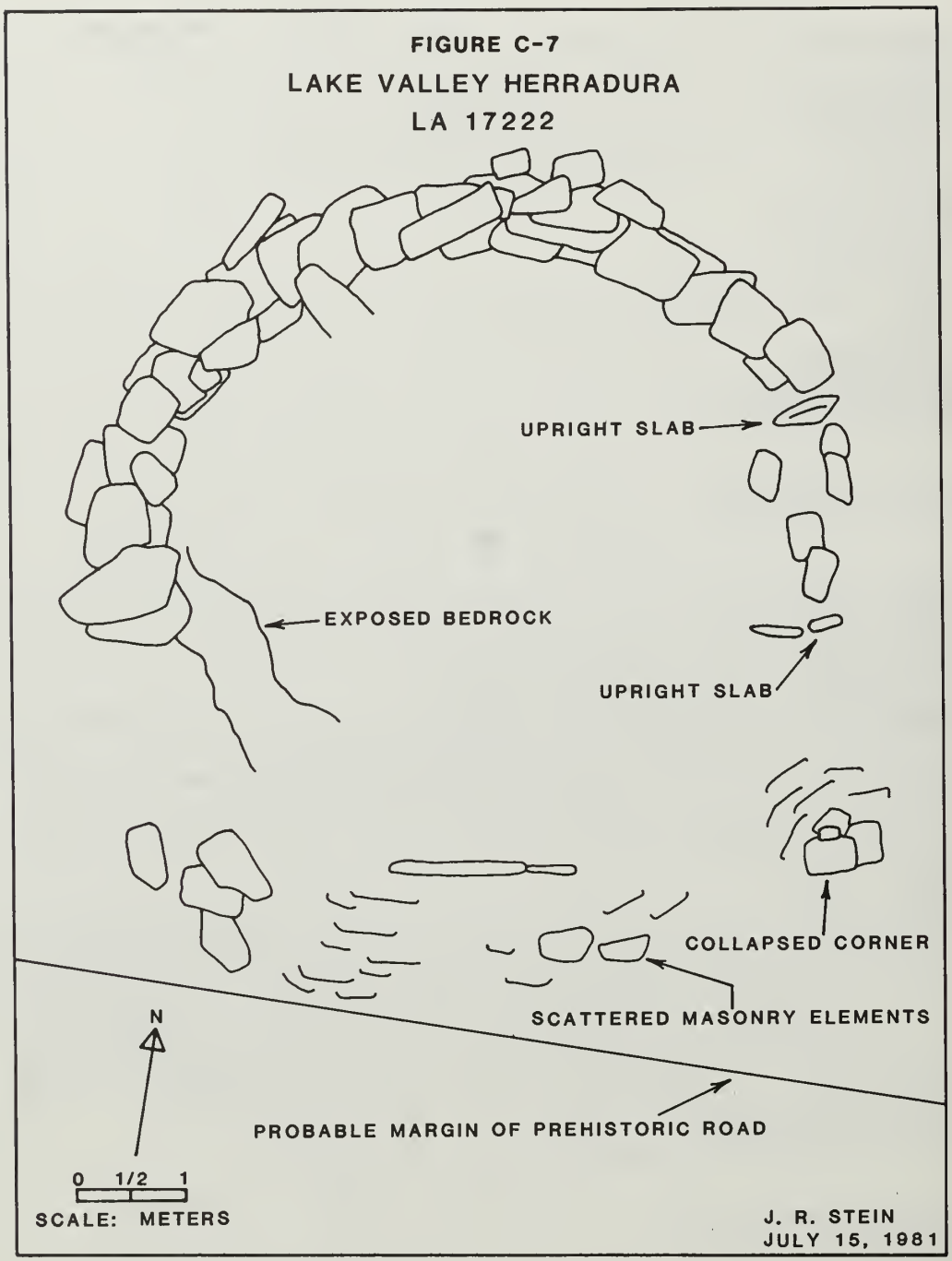
★

Site Name: Lake Valley Herradura
LA Number: 17222
Recorder: Michael Marshall
Temporal Affinity: Marshall: 1000-1125 AD; Weighted Ceramic: 895-1141 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Casa del Rio to Lake Valley Road
Topographic Situation: The site is located approximately 1.5 km south of the Chaco Wash on the western margin of a minor tributary to the Chaco. It is 2.5 km east-northeast of the Lake Valley Boarding School and is situated on an elevated open ridgetop.
Visible Horizon: Site situation affords a clear view of the Juan's Lake area, the Yellow Point Valley to the south and west, and Chaco Wash and Tse Ka'a to the north and east. The large paired cairns atop the cliff north of the Chaco can be seen at a bearing of 15 degrees.
Soil Structure: Sandy loam
Vegetation: Grasses, saltbush, wolfberry, snakeweed, prickly pear
Drainage: Chaco Wash
Elevation: 6040'
Site Description: Site consists of a "D"-shaped room of simple coursed masonry roughly 6 x 6 m in interior dimensions (see Figure C-7). The wall now stands to a maximum height of 4 courses (.4 m). The amount of rubble present suggests that the walls were low. Masonry elements are of dark brown sandstone intermixed with softer sandstone. Elements are unworked slabs averaging .4 x .4 x .05 m in dimension. Upright slabs may have been incorporated into the structural matrix. The structure appears to abut the prehistoric road alignment to the south, and either opens to the road or perhaps had an opening (now obscured) to the south-southwest. Fill is shallow and likely does not exceed .3 m. Orientation of the structure is roughly 170 degrees.
Associated Middens: No formal midden deposition is present; only a light scatter of cultural material exists in the site area.
Material Culture: Ceramics
From alignment west of feature (Sample No. 2):

	Jar	Bowl	Indeterminate
Undiagnostic Cibola Plain Ware	2		1
Cibola White Ware	3	4	
Red Mesa B/W		2	
Escavada B/W	1		
Gallup B/W	1		
Chuska Plain	2		3
Chuska Wide Banded	1		
Chuska White Ware	2		

Ceramics from immediate site vicinity (sample estimated at 10% of total):

Cibola Plain	8	2
Cibola Corrugated	7	



Undiagnostic Cibola White Ware	2	1	3
Gallup B/W	2	3	
McElmo B/W	2	1	
Chuska Corrugated	1		
Chuska Plain	2		
Undiagnostic White Mountain Red Ware	2		
Chuska Wide Banded	1		
Wingate B/R		1	

NOTE: Material concentrated within 15 m of structure

Ceramics: Road segment east of structure (Sample No. 3)

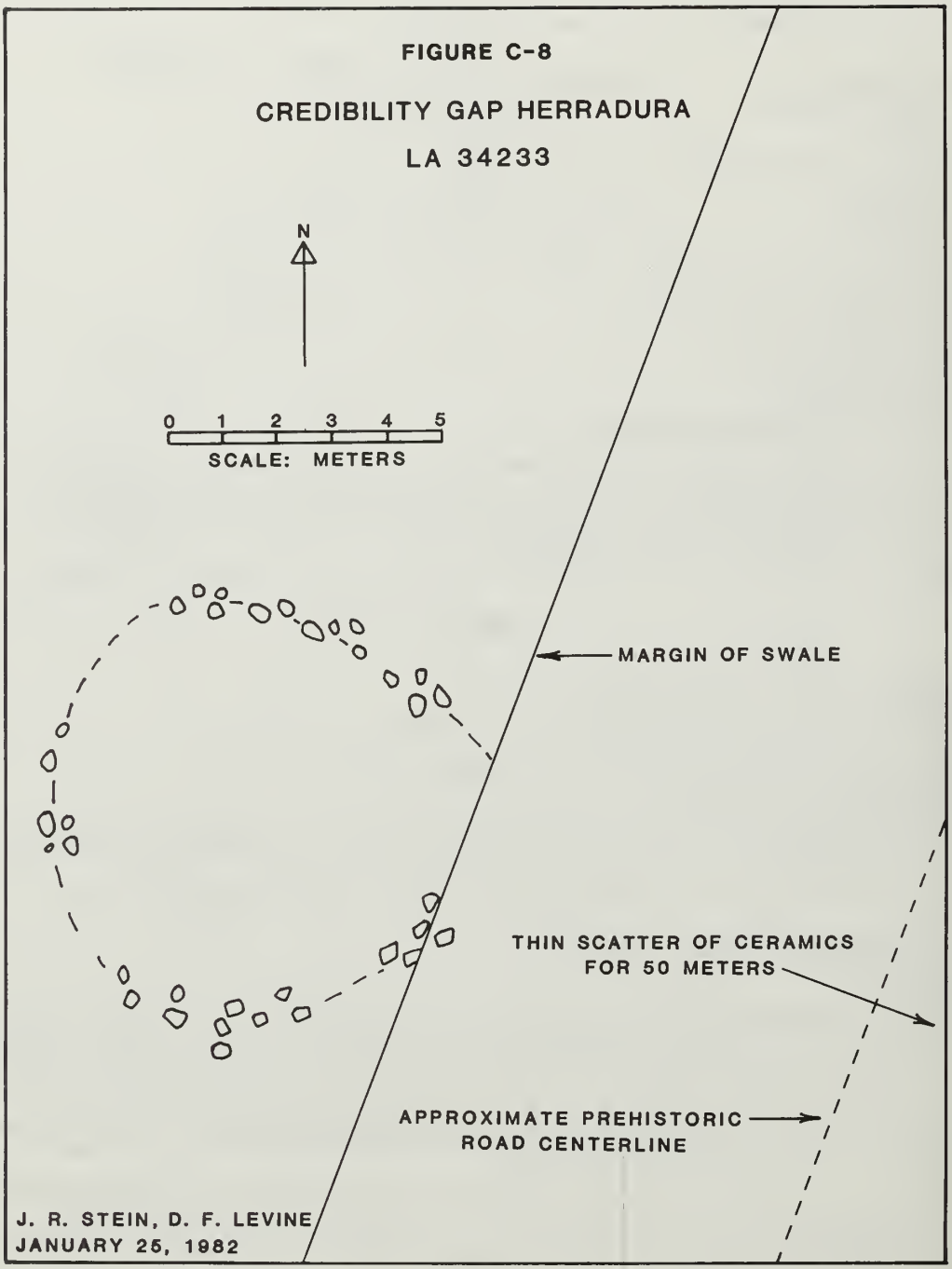
	Jar	Bowl	Indeterminate
Cibola Grey Ware			
Corrugated Indented	5		
Banded	3		
Plain	12		2
Undiagnostic Cibola White Ware	29	4	1
Red Mesa B/W	3	2	
Escavada B/W	3	1	
Gallup B/W	13	7	
Chaco B/W	1		
Mesa Verde White Ware			
McElmo B/W	3	11	2
Chuska Grey Ware			
Chuska Narrow Banded	1		
Chuska Plain	5		1
Chuska White Ware			
Red Mesa Style		1	
Undiagnostic White Mountain Red Ware		1	

Articulation with the Roadway: This structure appears to articulate directly with the roadway, as the swale clearly approaches the structure from the east on a bearing which would place the alignment adjacent and to the south of the structural remains. The swale is clearly visible and is approximately 7 m in width at this point. It is incised as it passes the structure, at a bearing of roughly 280 degrees.
Comments: The Casa del Rio to Lake Valley Road is visible in this location as a pronounced swale.

★

Site Name: Credibility Gap Herradura
LA Number: 34233
Other Numbers: Chaco Center Survey Number: 29 MC 1868
Recorder: J.R. Stein, D.F. Levine
Temporal Affinity: Marshall: 1000-1050 AD; Weighted Ceramic: 982-1160 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: South Road
Topographic Situation: Structure is situated on the crest of a high ridge flanking the Kin Klizhin Wash to the south. Here the South Road passes through a low saddle known as Credibility Gap, which is flanked by sandstone-capped mesitas.
Visible Horizon: South Gap, Fajada Gap, Upper Kin Klizhin, Hosta Butte, Satan Pass, and Tse Ka'a.
Soil Structure: Sandy loam
Vegetation: Grasses, saltbush, prickly pear
Primary Drainage: Kin Klizhin Wash
Elevation: 6570'
Site Description: Site consists of a distinct swale representing a segment of the South Road, associated with a horseshoe-shaped masonry feature (see Figure C-8). The feature is articulated with and located west of the swale, on the crest of a high ridge where long stretches of the South Road can be seen in the distance. At this location, the swale is about 15 m in width, .5 m in depth and bearing 20 degrees. It is easily discernible for 146 m. The associated structure measures 7 m in interior dimension and is constructed of tabular slabs and blocks of sandstone. Mound relief is approximately .3 m suggesting that the walls were approximately a meter in height and the structure probably unroofed.
Masonry: The structure is constructed of large irregular slabs of dense dark brown sandstone which outcrops locally. It is likely that these slabs were overlapped to form a compound wall.
Associated Middens: No formal midden deposition is associated with the structure. However, a light surface scatter of material, primarily ceramics, exists in an area extending 50 m to the east and 20-30 m north and south of the structure.
Material Culture: Ceramics
Total sample

	Jar	Bowl	Indeterminate
Cibola Grey Ware			
Plain (coarse temper)	2		
Plain (fine temper)	2		
Corrugated Indented (Tusayan style)	4		
Cibola White Ware			
Undiagnostic			5
Red Mesa B/W	3	1	



Escavada B/W	2	1
Gallup B/W	1	1
Carbon Painted White Ware		
McElmo B/W	2	5
White Mountain Red Ware		
Puerco B/R	1	

Material Culture: Lithics

1 Petrified Wood flake was noted in the site vicinity.

★

Site Name: Pierre's Ruin, The Acropolis, Unit A (Kin Bi Dagha Chii)
LA Number: 16509
Other Numbers: Chaco Center Survey Number: Pierre's Ruin A
Recorder: William Kight, Richard W. Loose, John R. Stein, Daisy F. Levine
Temporal Affinity: This site dates to around the first quarter of the twelfth century (Powers, Gillespie and Lekson 1983), based on tree ring specimens collected from the surface of Acropolis Unit B (LA 16508). Marshall: 1080-1125 AD; Weighted Ceramic: 1039-1157 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Unit A occupies the southern tip of the mesita known as the Acropolis. The flat bedrock cap of this mesita measures 90 m NS x 35 m EW, and stands over 30 m above the valley floor.
Visible Horizon: The summit of the Acropolis mesa is level with that of the badland pinnacle (LA 16514) described with El Faro. Accordingly the visible horizon is similar. Mount Taylor, Fajada Butte, South Gap, Hosta Butte, an unnamed prominent feature west of Hosta Butte, Tse Ka'a, Pretty Rock, White Rock/Stony Butte, Dalton Pass and Satan Pass are visible from the site area. It is likely that when the structure was standing that the Chaco-Gallegos divide could be seen.
Soil Structure: Bedrock
Vegetation: Grasses, sage, shadscale
Land Status: Bureau of Land Management
Primary Drainage: Unnamed lateral to Coal Creek
Elevation: 6500'
Site Description: Unit A (Bi Dagha Chii) is located on the southern edge of the mesita referred to here as the Acropolis consists of a massive structure of single-story construction (see Figure C-3). The original structural dimensions measured around 20 m EW x 16 m NS. Three contiguous housed kivas are aligned EW and compose the central core of the structure. These kivas are flanked to the south by a single row of small contiguous rooms which may have functioned in part to support the rear wall of the kiva housings, since the foundations for these rooms rest on the extreme southern margin of the mesa top. Uncharacteristically for structures of this type, Unit A is oriented to the north (obviously due to the unique relationship with Unit B, (Bi Dasha Tso) located 26 m distant). Rooms flanking the kiva housings to the north vary in size and are somewhat irregular in shape. What appears to be the remains of a room to the north of the westernmost kiva may in actuality be a rubble-filled platform/buttress or enlargement of that kiva housing. Mound relief of the structure approaches 2.5 m, suggesting that the entire structure was of single-story construction. At present the bedrock foundation and all but a small remnant of the easternmost kiva and its housing have collapsed, scattering rubble down the steep mesa slope. The location of Unit A with respect to Unit C is such that they form a gate to the top of the mesita. At this location an apparent ramp provides access to the mesa top from the southwest.
Masonry: Masonry elements utilized in Unit A are primarily dense, irregular, angular blocks of quartzitic sandstone mixed with the tabular material more common on the Basin floor. These masonry elements are incorporated into massive walls of rubble-core construction. Although the structure is reduced to a mound with rounded contours, wall alignments are for the most part easily defined. Wall widths average .5 m.
Rooms: Nine single story rooms were defined within the structural fabric of Unit A. As stated previously one of these rooms may represent a rubble-filled extension of the western kiva housing. An unknown number of rooms were lost in the collapse of the eastern kiva housing. Interior dimensions of rooms range from 1.5 x 2 m to 2.5 x 4 m.
Kivas: Three surface housed kivas are oriented in an EW alignment of contiguous housings. Kiva cylinders are partially visible suggesting a diameter of approximately 4 m for each of the three kivas. Only a fragment of the cylinder wall of the eastern kiva is still visible to verify the presence of that feature.
Plaza: A plaza surface is formed by the interspace between Unit A and Unit B. This space is featureless and bounded to the east and west by the margins of the sandstone cap of the mesita. The area created by the juxtaposition of the two ruins measures 27 m NS x 31 m EW. Unit C is situated at a diagonal to Unit A on the southwestern corner of the mesita. Seven meters separate the two structures, which define a formal entry onto the plaza surface from the ramp which gains access to the top of the mesita from the south-southwest.
Associated Middens: Material culture related to use of Unit A is scattered downslope to the east, south, and southwest of the rubble mound. This cultural litter is now intermixed with rubble from the collapsed eastern kiva and housing. Although formal midden deposition may exist at the base of the mesita beneath Unit A it is now largely obscured by colluvial deposition and remains undefined.

Material Culture: Lithics

Chinle Chert	1
Chalcedonic Petrified Wood	1 (knife tip)
Dark Petrified Wood	1 (knife)

Articulation with the Roadway: Articulation of the Acropolis at Pierre's group with the North Road appears to have been accomplished via a spectacular ramp which diverges from the North Road alignment at a point south of the gate at El Faro. This point is roughly marked today by the intersection of a new site boundary fence and a nearby wash. This spur diverges from the North Road alignment and enters the Acropolis through the formal entry created between Units A and C. The ramp was almost certainly constructed for it forms a linear incision into the steep slope of the mesita. The feature averages 6 m in width, however depth varies somewhat due to the scouring of years of erosion. The lower third of the feature has been reduced to an incised gully. The ramp shows clearly on color video coverage of the North Road taken by Rich Loose and John Stein for the Public Service Company of New Mexico in 1981 and on infra-red coverage of road taken in 1973 by Irwin-Williams. Unfortunately, no special characteristics of the feature other than the incised linearity are evident from the ground. The steepness of the feature no doubt accelerated its erosion, rendering any special characteristics such as masonry steps indistinguishable from the surrounding terrain. It is likely, however, that these existed judging from the scattered distribution of associated rubble, the steepness and linear nature of the feature, and evidence for a prepared "sill" in the sandstone cap where access is gained to the top of the mesita. Possibly associated with the ramp is a linear roomblock (LA 16523) situated on the northern margin of the ramp approximately midway up the mesa slope. This is Site No. 14 in the Chaco Center Outlier Survey (Powers, Gillespie and Lekson 1983) which was documented as consisting of two contiguous rooms connected to a long wall which extended for at least 7 m downslope. A pronounced swale exists upslope from the two rooms which suggests that an alignment may have existed between the area south of El Faro and a point midway up the ramp. Powers was correct in assuming that this site was associated in some way with access to the top of the mesita (Powers, Gillespie and Lekson 1983).
Condition: This ruin is naturally reduced to rounded contours and is stable. As mentioned previously, the eastern portion of the structure has collapsed and is beyond reconstruction.
Comments: The structural layout of Unit A is mildly suggestive of the "batteries" of elevated kivas characteristic of McElmo phase buildings such as those found at Kin Kletso, the upper elevation of Chetro Ketl, and Aztec Springs (Yucca House). Surface housed kivas commonly occur as single or double units south and west of the Canyon, although a single kiva is definitely the norm for this type of Bonito Style structure. Although subtle, the alignment of 3 single story kivas and the diameter of the kivas and sizes of the rooms relative to the structural mass hint strongly of the McElmo period.

★

Site Name: Pierre's Ruin, The Acropolis, Unit B (Kin Bi Dagha Tso')
LA Number: 16508
Other Numbers: Chaco Center Survey Number: Pierre's Ruin B
Recorder: William Kight, Richard W. Loose, John R. Stein, Daisy F. Levine
Temporal Affinity: This site dates to around the first quarter of the twelfth century, based on tree ring specimens collected from the surface of this structure during the Chaco Center Survey (Powers, Gillespie and Lekson 1983); Marshall: 1080-1125; Weighted Ceramic: 984-1160 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Unit B is roughly centered on the top of the mesita referred to herein as the Acropolis. As such it is the northernmost of the three Bonito Style structures which are located on the summit.
Visible Horizon: An elevated aspect of this unit (Room No. 1) which was of sufficient mound relief to have been of two story construction, likely afforded this structure superior visibility over Unit A. See Unit A for a description of the visible horizon.
Soil Structure: Sandstone bedrock
Vegetation: Grasses, sage, shadscale
Land Status: Bureau of Land Management
Primary Drainage: Unnamed lateral to Coal Creek
Elevation: 6500'
Site Description: Unit B consists of a massive square building of 11 rooms arranged around a single surface housed kiva so as to form a rectangle 18 x 19 m in maximum dimensions (see Figure C-3). Mound relief approaches 3.5 m at Room No. 1 indicating that this feature, which flanks the kiva to the west, is probably of two story construction. The remainder of the structure appears to be single story although ceilings were probably high.
Masonry: Masonry is consistent with that described for El Faro (LA 16515) and Unit A (LA 16519). An exposed vent shaft for the single central kiva exhibits use of tabular sandstone masonry. As with El Faro, the dense quartzitic sandstone has resisted weathering sufficiently to form a mound of angular character. Walls are of massive rubble-core construction more than .5 m in width.
Rooms: Room shapes are generally rectangular, but some irregularity in layout has resulted in inconsistency in room shape. Room sizes range from 3 x 3 to 5.5 x 6 m in interior dimensions. Wall alignments are clearly visible. Room No. 1, the largest represented in the structure, appears to be a two story construction and might cautiously be termed a tower. However, there is

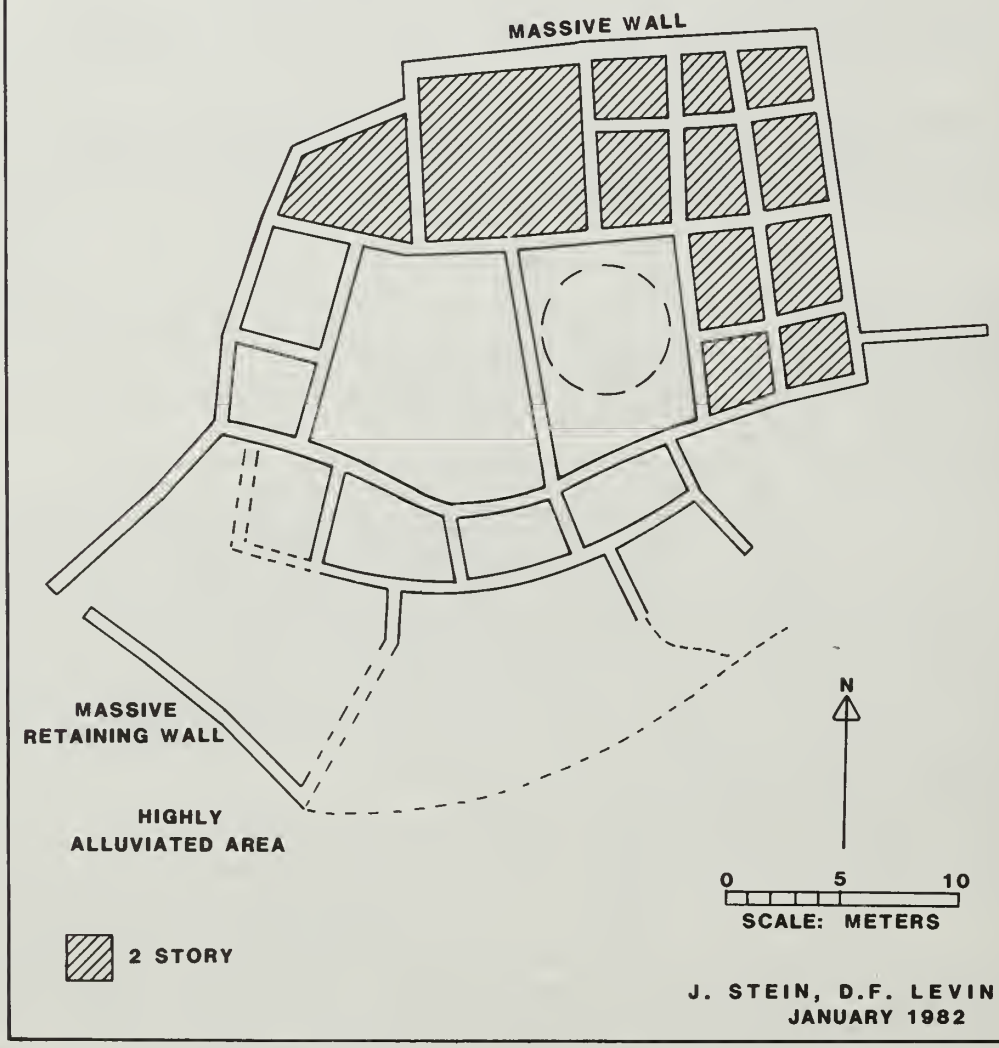
no evidence for a kiva cylinder within the feature and there is not sufficient rubble present to suggest the mass necessary for a tower kiva. The tower is west of and contiguous with the kiva housing.
Kivas: A single surface housed kiva provides the focus of this structure. The kiva measures approximately 5 m in diameter and is housed within a room 7.5 x 7.5 m in interior dimensions. Unfortunately a portion of this kiva has been vandalized exposing the ventilator and damaging the interface between the tower and the kiva housing.
Plaza: An apparent doorway in Room No. 8 on the southeastern corner of the structure opens onto the plaza. For a discussion of the relationship of the structure to the plaza refer to the description provided for Unit A.
Associated Middens: Material culture originating from use of Unit B is strewn downslope to the east. Definition of formal midden deposition is impossible due to erosion and colluviation on the steep slope. Material culture on the mesa top is surficial and sparse.
Articulation with the Roadway: Refer to discussion in Pierre's Unit A. Note an additional possible "ramp" on the northwestern tip of the mesita. Access at this point would imply use of the mesa top north of Unit B as a possible court or plaza bounded by the steep edge of the mesita.
Condition: Relatively little looting activity has been focused on the structure in the recent past. Damage is generally limited to the kiva and portions of the east wall of the tower.
Comments: The structural layout of Unit B is a plan common for small Bonito Style structures. Wall irregularity, slightly smaller kiva diameter than normal and presence of the elevated rectangular tower suggest the McElmo expression of the Bonito Style. Elevated large rectangular rooms such as Room No. 1 seem to be indicative of this period.

★

Site Name: El Faro
LA Number: 16514-16515
Other Numbers: Chaco Center Survey Number: Pierre's Group No. 6
Recorder: John R. Stein, Daisy F. Levine
Temporal Affinity: Marshall: 1080-1125 AD; Weighted Ceramic: 1040-1137 AD
Cultural Affinity: Eastern Anasazi, Chaco-McElmo Expression
Road Association: North Road
Topographic Situation: The primary architectural aspect of the ruin is situated at the southern base of a prominent pinnacle (LA 16514) which is "cone"-shaped and towers more than 100 feet above the alluvial valley of an unnamed drainage. The cone, which is an erosional badland remnant, is capped by a dense quartzitic sandstone showing evidence of repeated fires. Quantities of masonry rubble are strewn down the slopes of the pinnacle suggesting that a massive structure, perhaps a "platform" or housed kiva such as those at Bis'a'ani were constructed here. Although not architecturally contiguous with LA 16515 (located at the base of this topographic feature) the juxtaposition of the two structures suggests that they functioned as one, the lower incorporating the badland pinnacle to achieve a natural "tower."
Visible Horizon: The summit of the cone affords a commanding view of the surrounding terrain. Visible features include Mount Taylor, Fajada Butte, South Gap, Hosta Butte, an unnamed prominent feature west of Hosta Butte, Tse Ka'a, Pretty Rock, White Rock/Stony Butte, Dalton Pass and Satan Pass. The Pierre's area can be seen from several shrines (eg. 29 SJ 706) on the south rim of Chaco Canyon.
Soil Structure: Grades from badland clay to clay/sand alluvium
Vegetation: Miscellaneous range grasses, greasewood
Primary Drainage: Unnamed lateral to Coal Creek, Denazin and Chaco Washes
Elevation: 6420-6500'
Site Description: As described previously El Faro consists of two architectural units connected via the incorporation of a natural topographic feature (see Figure C-9). The uppermost structural aspect of the ruin is presumed to represent the remains either of a housed kiva or less likely an artifical platform intended to increase the useable space atop the pinnacle. The narrow sandstone cap of the pinnacle exhibits evidence for repeated large fires. The location of this feature with respect to the North Road suggests some type of signalling, engineering or guidance function. Unfortunately the upper unit (LA 16514) has almost totally collapsed leaving large quantities of masonry strewn down the slopes of the pinnacle. The lower structural unit (LA 16515) is unquestionably the largest Bonito Style structure within Pierre's Group. Although the ruin is basically rectangular in layout, irregularity of cell size and wall placement is strongly reminiscent of the architectural style understood to be McElmo. More than seventeen single story rooms and 12 second story rooms are represented within the structural matrix. These rooms surround 3 enclosures which may house kivas. A low enclosed plaza is evident contiguous with the southwestern corner of the structure.
Masonry: An impressive rubble mass constitutes the mound at El Faro. Masonry elements are a dense quartzitic sandstone derived from local outcrops. Unlike the more familiar dense indurated dark brown sandstone more common in the Basin floor this local material is available as large irregular blocks, seemingly unsuited for Chaco style masonry which we have come to view as characterized by even courses of tabular material. Nonetheless the irregular

FIGURE C-9

EL FARO LA 16515



chunks of quartzitic material are laid up to form a core-and-veneer wall ranging from .5 to 1 m in thickness. There is no evidence for shaping of the masonry elements yet the exposed walls exhibit smooth even surfaces. Some tabular material is present as chinking. Of particular note is the condition of the rubble mound; the masonry elements have proven sufficiently resistant to weathering so as to retain the crisp definition of the individual cells within the structure. The large rooms presumed to be kiva housings have not collected the expected sand fill and neither has sage and greasewood conquered the mound. The overall effect is that the structure appears to have collapsed only yesterday.

Rooms: In some instances rooms identified as second-story may actually represent single-story constructions with abnormally high ceilings. The massive character of the rubble mass suggests that second story constructions are present within the structural matrix. Room sizes (wall center to wall center) range from 3 x 3 m to 4 x 5 m. Of the 3 enclosures tentatively identified as kiva housings 2 may actually represent large deep rooms. Room No. 2 (see Figure C-9) measures 7.25 x 7.25 m in interior dimensions and is somewhat elevated. Room No. 3 is irregular in shape and measures 11 x 10 m maximum interior dimensions. The roof of this feature would form an elevated court flanked by upper story rooms. These 2 features of El Faro are described as rooms due to the apparent absence of the masonry kiva cylinder within the supposed housing. Given the asymmetry in site layout (which is inconsistent with the usual plan for this type of structure) it may very well be that these cells do not house kiva cylinders but rather form a type of masonry "vault".
Kivas: Kiva Housing No. 1 (see Figure C-9) contains the characteristic depression of a kiva. The housing is somewhat rectangular in shape and measures 6.5 x 9 m in interior dimensions. A kiva 6 m in diameter is likely housed within the feature. The kiva roof forms a surface consistent with that of Room/Kiva No. 3 and would, therefore, be an aspect of the elevated court. Based on the elevation of the rubble mass this housed kiva apparently was elevated to a single story level and constructed entirely above the ground surface. The kiva was flanked by second story rooms on the north and east.
Plaza: Wall alignments suggest that a plaza enclosed by low retaining walls was appended to the southwest corner of the structure. Exact configuration of this plaza is not known due to accumulation of alluvial or colluvial deposition. At least a portion of this feature measures 11 x 13 m not including rooms which apparently were constructed within the enclosure. Occasional masonry elements in the colluvial fill south of the rubble mound suggest that the outside retaining wall may have continued for an unknown distance beyond the structure. At least one wall (the southernmost) was massive in character, probably of rubble-core construction 1 m or less in height. There is an obvious opening in this wall on the southwest corner which may be a gate, approximately 2 m in width. Projected alignments of the North Road point to its articulation with this ruin in the vicinity of this feature.
Associated Middens: The area where material culture and construction detritus could be expected to accumulate is now mantled by considerable colluvial deposition. A midden surface is, however, visible 25 m southeast of the southeast corner of the rubble mound. This midden measures 10 m EW x 26 m NS and is characterized by moderate material culture density, ashen soil, fire-reddened spalls etc. Depth of the midden deposition is estimated at greater than .5 m.
Material Culture: Ceramics
From rubble mound and vicinity*

Cibola Grey Ware	
Plain	4
Corrugated Indented	5
Cibola White Ware	
Undiagnostic	1
Escavada B/W	2
Carbon Paint White Ware	
McElmo B/W	1

*No sample was taken from the midden surface

Material Culture: Lithics

Chalcedony core	1

Articulation with the Roadway: The projected alignment of the North Road passes through the lower ruin (LA 16515) in direct alignment with the summit of the pinnacle at the upper ruin (LA 16514).
Site Condition: The lower El Faro structure is presently naturally reduced and stable. Unfortunately the upper structure has collapsed leaving the structural matrix beyond reconstruction.
Comments: The El Faro structure is unique among the Bonito Style buildings known from the Basin floor. The asymmetrical utilization of Bonito Style elements, the extraordinary mass of the structure, and the incorporation of large roofed vaults into the structural fabric is unusual. The unique relationship of the ruin with the North Road and other nearby great houses makes this ruin extremely significant.

★

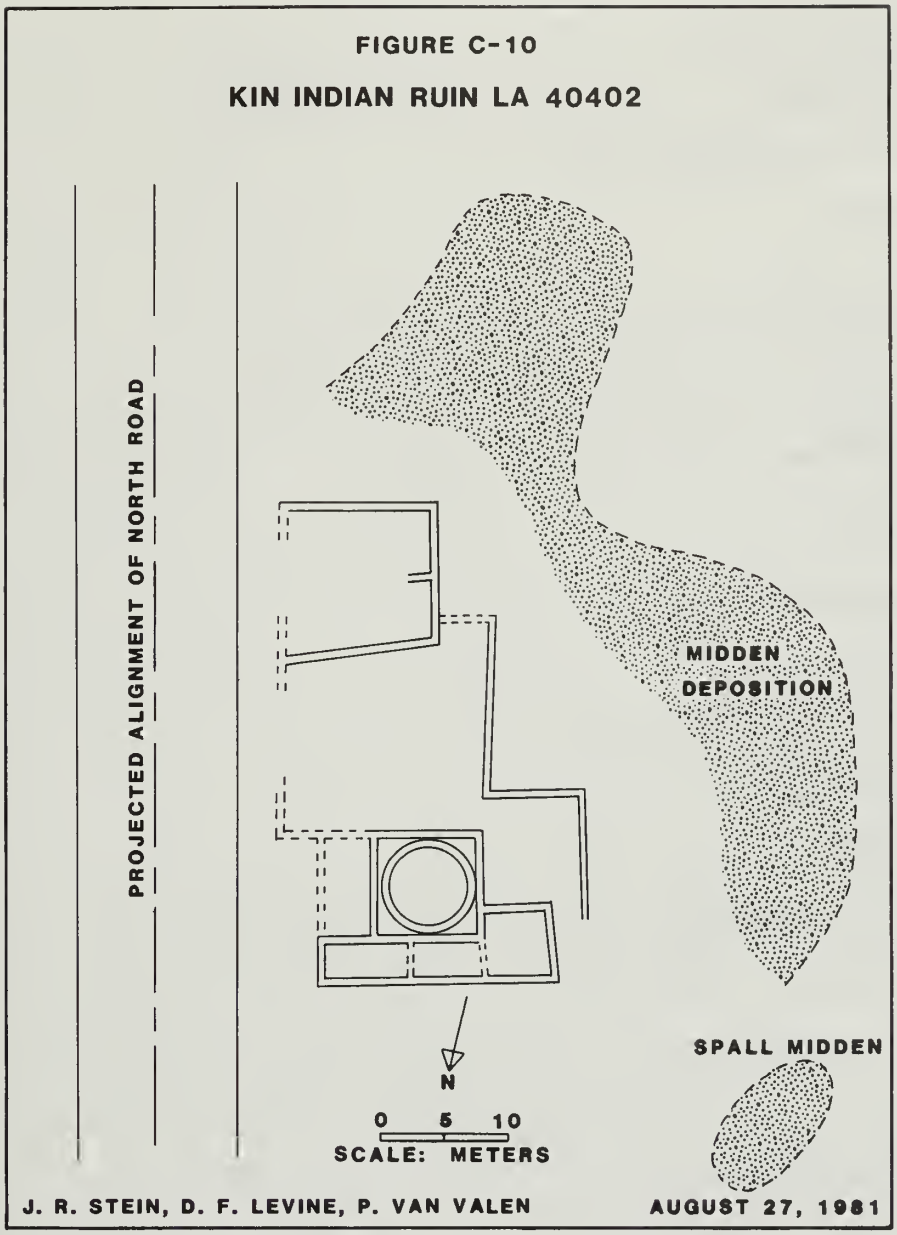
Site Name: Kin Indian Ruin*
*It has been suggested (C.R. Morrison 1981: personal communication) that this ruin be designated "Yumer's Ruin" after a slab found there by Mrs. E.H. Morris in 1947. The slab read "Col. H.F. Yumer" with a pair of crossed sabers lettered "C" above and "L" below. However, there was apparently never a Yumer in the U.S. Army. (C.R. Morrison 1981: personal communication.)
LA Number: 40402
Other Numbers: Chaco Center Survey Number: 29 SJ 402
Recorder: John R. Stein and Daisy F. Levine

Temporal Affinity: 1000-1125 AD; Weighted Ceramic: 982-1149 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Kin Indian Ruin is situated on the crest of the ridge which forms the northern margin of the Escavada Valley. The ruin is situated some 40 m above the Escavada and 1.6 km north of the wash margin. The contemporary road from Nageezi to Chaco Canyon passes 100 m east of the ruin which forms a conspicuous landmark for the informed passerby.
Visible Horizon: The location of Kin Indian Ruin affords a commanding view of the entire Chaco North area including Pueblo Alto. The elevated situation of the ruin ensures that it can be seen from both the north and south margins of the Chaco Canyon rim, from such shrines as 29 SJ 706 and the Poco Site. The ruin has a clear view of the Chaco-Escavada confluence and may be visible from Pierre's Ruin. It also overlooks the confluence of the Escavada and the Kimbeto Washes.
Soil Structure: Sandy loam
Vegetation: Miscellaneous range grasses, snakeweed, wolfberry, chamisa, saltbush, sage
Primary Drainage: Escavada Wash to the Chaco Wash (Kimbeto-Escavada Confluence)
Elevation: 6270'
Site Description: Kin Indian Ruin consists of a Bonito Style roomblock containing 4 to 6 single story rooms, an elevated housed kiva and 2 plazitas which articulate directly with the North Road (see Figure C-10). Maximum structural dimensions of the ruin are 37 x 25 m. The structure is reduced to a massive rubble mound 3.5 m in maximum relief. The structure appears to have been terraced from south to north with the northern roomblock having the highest elevation. It is unlikely that a second story is represented within the structural matrix. Rather, it is probable that the northernmost rooms had high ceilings (over 3 m) and that the raised kiva may be partially subterranean.
Masonry: Kin Indian Ruin is constructed of dense dark brown sandstone slabs and blocks of moderate proportions (averaging .3 x .3 x .1 m), which are incorporated into massive walls of rubble core-and-veneer construction. Wall thickness ranges from .5 to .7 m. Wall construction is much more massive than necessary for the size of the structure. The source of the masonry elements is problematical as outcrops of this material do not occur in the immediate vicinity of the ruin. Although the structure is reduced to a mound with rounded contours, wall alignments are generally visible.
Rooms: Four to six single story rooms are believed to exist within the architectural matrix of Kin Indian Ruin. These rooms flank the central raised kiva to the north and may have been slightly elevated above the court created by the kiva roof. Two additional rooms may be incorporated into the western wall of the south plaza. Width of the rooms varies from 2.5 m to 3 m. Length of the rooms is uncertain.
Kivas: A single elevated housed kiva is incorporated into the roomblock. The kiva is a single story construction housed within a square masonry room 8.5 x 8.5 m in exterior dimensions. The kiva cylinder is constructed of core-and-veneer masonry consistent with the housing, and measures 6 m in interior diameter.
Plazas: Two contiguous plazas are evident at the southern margin of the structure. The northernmost plaza appears to open onto the North Road and is almost square, measuring 15 x 14 m. The southern plaza is contiguous to the south and is also square, measuring 10 x 10 m. The western wall of the southern plaza enclosure exhibits considerable mound relief, suggesting either massive wall construction or 2 contiguous rooms incorporated into the wall.
Associated Middens: Midden deposition is concentrated primarily to the west and southwest of the structural remains and is contiguous with the rubble mound. Material on the surface is of moderate density and consists primarily of sherd and lithic material interspersed with spalls and masonry slabs. Midden configuration appears to be bifurcated extending from the house in two lobes to the west and south-southwest. Maximum extent of the midden is 30 m from the house. The size of the midden is approximately 1,196 square m. With an average depth of deposition at .5 m, 598 cubic m of cultural detritus may be represented.
Spall Middens: A concentration of spalls probably representing construction debris is located 20 m northwest of the northwest corner of the house block. The midden is 10 x 5 m in extent and approximately .5 m in depth. No cultural material was noted in association with the midden.
Material Concentration: A concentration of ceramics, slabs, and spalls continuing for 30 m east and south of the rubble mound was noted in the vicinity of the road alignment. The location of the material suggests the presence of a masonry curb or other architectural formalization of the road as it passes and articulates with Kin Indian Ruin.
Ceramics associated with possible curbing:

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Banded	1			1
Corrugated	1			1
Plain	1		2	3
Cibola White Ware				
Undiagnostic	2			2
Gallup B/W	1			1

FIGURE C-10

KIN INDIAN RUIN LA 40402



Chuska Grey Ware				
Corrugated Indented	1			1
White Mountain Red Ware				
Undiagnostic	1			
TOTAL:				11

Material Culture: Ceramics
2 x 2 m sample grid 37 m downslope south from kiva:

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Corrugated Indented	4			4
Plain			1	1
Cibola White Ware				
Undiagnostic	1	4		5

Escavada B/W		1		1
Gallup B/W		1		1
Chuska Grey Ware				
Corrugated Indented	3			3
TOTAL:				15

Grab sample from general midden surface:

Cibola Grey Ware				
Banded	4			4
Corrugated Indented	45	1		46
Plain	7	2	3	12
Cibola White Ware				
Undiagnostic	7	2		9
Escavada B/W	2			2
Gallup B/W	9			9
Carbon Paint B/W				
McElmo B/W	1	2		3
Chuska Grey Ware				
Corrugated Indented	20			20
Plain	3			3
Chuska White Ware				
Undiagnostic	1			1
TOTAL:				112

Material Culture: Lithics
2 x 2 m sample

Chinle Chert	2
Dark Petrified Wood	2

Grab sample from general midden surface:

Washington Pass Chert	1
Dark Banded Petrified Wood	7
White Chert	1
Quartzite	1
Red-Brown Chert	1
Miscellaneous Petrified Wood	5

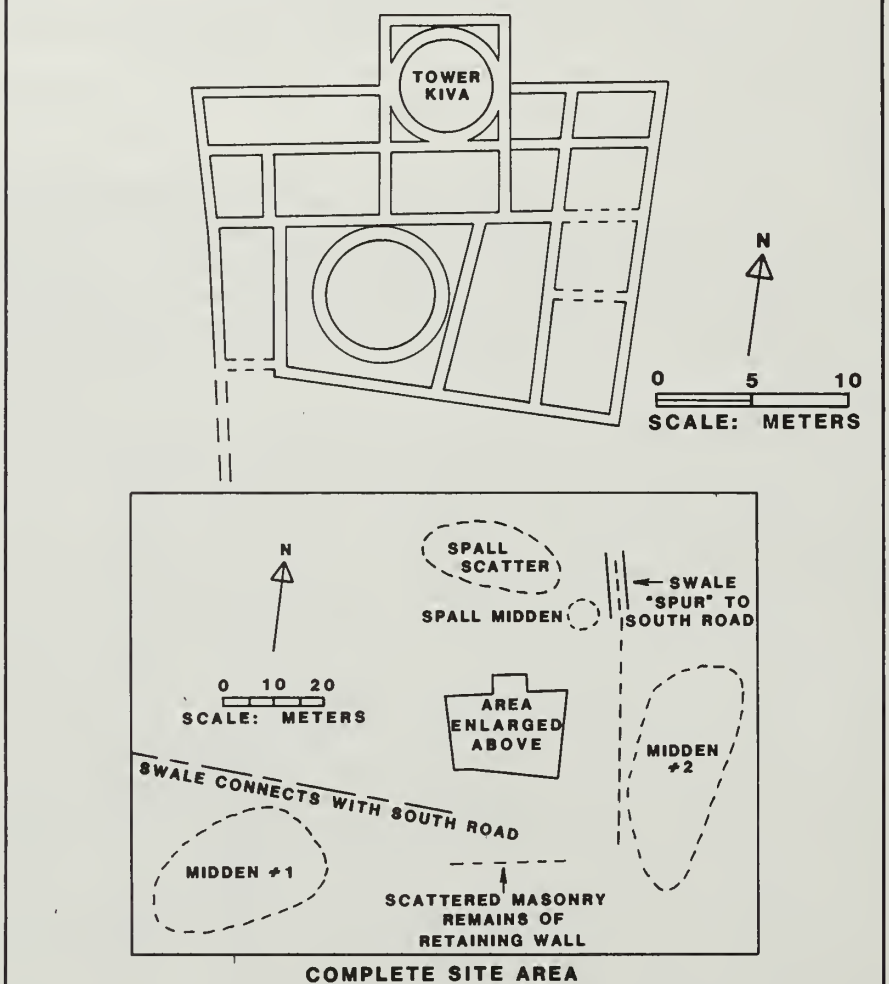
Articulation with the Roadway: The structural remains of Kin Indian Ruin appear to articulate directly with the North Road, which passes the ruin to the east.
Condition: The ruin is reduced and stable with only minor recent potting activity apparent. Two cairns have been piled atop the rubble mound in historic times and may serve as "shepherd seat." Historic debris in the immediate site area consists of several tinned meat and beverage cans.
Comments: Kin Indian Ruin represents the first Bonito Style outpost to be encountered north of Chaco Canyon. Just as Pueblo Alto rests on the crest of the southern margin of the Escavada Valley so Kin Indian Ruin rests on the crest of the northern margin. A distance of 5 km separates the two ruins. Within this area the North Road is dramatically visible on the aerial imagery suggesting that the road was formalized or intensively maintained within this area. The association of Kin Indian Ruin with the North Road is clearly visible on a video tape taken early in 1981 (by Richard Loose and a film crew from Public Service Company of New Mexico), as well as on BLM low sun angle photography taken later that same year. Kin Indian Ruin is the second-largest Bonito Style structure associated with the North Road (Pierre's Ruin is the largest). The location of Kin Indian Ruin with respect to Chaco Canyon and particularly the area known as Chaco North suggests that the site may have been located in a strategic situation. Many answers relevant to inquiry into the function and character of the North Road may lie with Kin Indian Ruin.

Site Name: Upper Kin Klizhin
LA Number: 34245
Other Numbers: CRP Field No. S-38
Recorder: John R. Stein, Daisy F. Levine
Temporal Affinity: Marshall: 1000-1050 AD; Weighted Ceramic: 821-1074 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: South Road, possibly the Rincon Road

Topographic Situation: Site is situated on the crest of a narrow ridge perpendicular to the Kin Klizhin Wash. The structure is situated 700 m north and 15 m above the valley bottom. Although located in an elevated position, the location structure is flanked to the north (ca. 100 m) by the caprock of a low mesa which precludes visibility to the north. The mesa backdrop would prelude visibility of the structure from the south.
Visible Horizon: Tse Ka'a (32 degrees), South Gap (341 degrees), Mesita de la Junta (190 degrees), notch above Casa Patricio (195 degrees--Casa Patricio is not visible), White Rock, Stony Butte, and possibly Kin Klizhin.
The site is situated so as to have clear visibility of the Kin Klizhin Valley.
Soil Structure: Sandy loam
Vegetation: Grasses, snakeweed, saltbush, and wolfberry
Primary Drainage: Kin Klizhin Wash
Elevation: 6350'
Site Description: The Upper Kin Klizhin house consists of a matrix of rectangular rooms constructed so as to terrace up to and support the mass of a tower kiva (see Figure C-11). Although dimensions of the ruin are modest (35 x 23 m), the rubble mass is substantial (mound relief is estimated at 7.5 m). The primary components within the architectural matrix consist of a housed or blocked-in surface kiva flanked on the north and east by a double row of large rectangular rooms. The northern block appears to have been of second-story construction to provide support for the tower kiva, which is centered within the rear roomblock and comprises the highest elevation of the rubble mound. In all, 12 possible single story rooms and 8 possible double story rooms, in addition to a surface courtyard kiva, a plaza area, and a tower kiva comprise the structural remains.
Masonry: Masonry elements utilized in construction of the Upper Kin Klizhin house consist of angular slabs of well indurated dark brown sandstone. This material is ubiquitous within the immediate Upper Kin Klizhin area and it has been extensively quarried even recently. The masonry elements show no evidence of modification, and average .30 x .25 x .5 m in size. Walls are of rubble-core construction and are massive, averaging .5 m in thickness. Where walls are exposed, banding is not apparent; however, chinking spalls were liberally used.
Kivas: Elevated Housed Kiva: A surface kiva is housed in a single-story "housing," 8 x 7.5 m in maximum dimensions. This elevated courtyard measures 14.5 x 9.5 m in maximum dimensions and is somewhat trapezoidal in shape. A slight depression indicates the presence of a surface kiva 6-7 m in diameter. Kiva walls are obscured by rubble and are not visible.
Tower Kiva: The remains of the tower kiva consist of a conspicuous mass of rubble which forms a masonry "plug" on the rear wall of the structure. This feature comprises the highest relief of the mound, 7.5 m from the lower plaza wall, and roughly 3.5 m from the present surface north of the structure. Portions of the north, east, and west walls of the kiva housing are visible and a housing 6.5 x 6.75 m was measured. Although no internal kiva walls are visible, a cylinder of 5 m in diameter is estimated. Reduction of the housing has been accelerated by the failure of the corners, in particular. The northeastern and northwestern (outside) corners have collapsed into a tremendous mass of rubble. Although the tower kiva is almost the exact dimensions of that of Kin Klizhin, buttressing is provided by contiguous rooms which abut the center of the east and west wall of the housing, leaving the north half unsupported (see Figure C-11).
Upper Kin Klizhin may have pre-dated Kin Klizhin. This type of buttressing may have proven unsatisfactory at the time of occupation and was corrected in the later structure. The similarity of Upper Kin Klizhin to Kin Klizhin in lay-out and structure mass suggests that the tower kiva of Upper Kin Klizhin contained a stack of at least 3 cylindrical rooms and stood at least 9 m above original ground surface (Marshall et al. 1979:70).
Plaza: A plaza area 17 x 18 m in extent is indicated by the surficial alignment of masonry parallel to and 17 m south of the primary rubble mound. The alignments appear to be a collapsed core-and-veneer wall of substantial proportions which has been obscured by fill. An additional alignment extending southward from the western margin of the block indicates that the plaza was enclosed. Projected centerline of the spur, which connects Upper Kin Klizhin with the South Road, places the lower plaza wall very close to, and perhaps along the margin of, that road.
Associated Middens:
Midden No. 1: This midden is situated 30 m southwest of the southwest corner of the roomblock. The concentration of cultural material measures 20 x 35 m, with a depth of ca. 1 m. Eight square meters of the midden surface were sampled. Cultural material was present in moderate density; spalls, burned spalls, and sherds were present.
Midden No. 2: This midden is located 13 m east of the southeast corner of the roomblock. It measures 43 m NS x 17 m EW; depth is estimated at 1 m. Spalls are present in the midden indicating possible structural remains.
Spall Middens: Two spall middens are present north and northeast of the tower kiva. Spall Midden No. 1 consists of a superficial scatter of spalls intermixed with sherds measuring 15 m NS x 23 m EW. It is located north of the tower kiva. Spall Midden No. 2 is located 15 m northeast of the tower kiva and consists of a mound of spalls 30 m in depth and approximately 6 m in diameter.
Overall site area exhibits a substantial amount of cultural litter; ground stone and formal artifacts are not prevalent.

FIGURE-C-11

UPPER KIN KLIZHIN LA 34245



J. R. STEIN, D. F. LEVINE JANUARY 15, 1982

Midden Samples: Samples consist of two 2 x 2 m samples in Midden No. 1 (south midden), one 2 x 2 m sample in Midden No. 2 (east midden), and one grab overall lithic sample for each midden.
Material Culture: Ceramics

Midden No. 1, Sample No. 1: 2 x 2 m

	Jar	Bowl	Indeterminate	Total
Cibola Utility				
Plain (coarse temper)	3		19	
Banded (wide smoothed)	2			

Banded (narrow unsmoothed)	2			
Corrugated (Medicine Style)	11			
Corrugated (Tusayan Style)	18			
Undiagnostic Cibola White Ware	6	4	5	
La Plata B/W			1	
Escavada B/W	3	1		
Gallup B/W	8	1	1	
McElmo B/W	1			
Undiagnostic Chuska White Ware	1			
Undiagnostic White Mountain Red Ware	1			
TOTAL:				88

Midden No. 1, Sample No. 2: 2 x 2 m

	Jar	Bowl	Indeterminate	Total
Cibola Utility				
Plain (coarse temper)	4		28	
Banded (narrow unsmoothed)	1			
Corrugated Indented				
Medicine Style	2			
Tusayan Style	1			
Undiagnostic Cibola White Ware		1		
La Plata B/W	4			
Red Mesa B/W	3	3		
Escavada B/W	1			
Gallup B/W		1		
Lino B/G		1		
Chuska Corrugated (Exuberant)	3			
Chuska Plain Incised	1			
Undiagnostic San Juan Red Ware		1		
Puerco B/R		1		
TOTAL:				56

Grab Sample: Area south and southwest of roomblock

	Jar	Bowl	Indeterminate	Total
Cibola Utility				
Plain (coarse temper)	6		2	
Plain (fine temper)			3	
Banded (narrow unsmoothed)	1			
Corrugated (Medicine Style)	9			
Corrugated (Tusayan Style)	27			

	Jar	Bowl	Indeterminate	Total
Undiagnostic Cibola White Ware	1	3	1	
La Plata B/W	1			
Red Mesa B/W	4			
Escavada B/W	2	2		
Gallup B/W	9	3		
Chaco B/W		1		
Undiagnostic Mesa Verde White Ware	2	1		
McElmo B/W	4	2		
Chuska Utility				
Plain	1			
Chuska Corrugated (Exuberant)	1			
Chuska Corrugated (Hunter Style)	1			
Chuska White Ware				
Undiagnostic		1	1	
Red Mesa Style	1			
White Mountain Red Ware				
Undiagnostic	1			
Puerco B/R		1		
Other				
Tusayan White Ware		1		
Black Mesa B/W	1	1		
TOTAL:				95

Midden No. 2: 2 x 2 m

	Jar	Bowl	Indeterminate	Total
Cibola Utility				

Plain (coarse temper)	2	1		
Plain (fine temper)			1	
Corrugated (Medicine Style)	4			
Corrugated (Tusayan Style)	4			
Cibola White Ware				
Undiagnostic		1	1	
Red Mesa B/W	1			
Escavada B/W	2	1		
Gallup B/W	5	1		
TOTAL:				24

Material Culture: Lithics
Sample No. 1, Midden No. 1: 2 x 2 m

Red Dog Shale	1
Dark Petrified Wood	1

Grab sample south of roomblock:

Basalt	1
Chalcedony	1

Sample No. 2, Midden No. 1: 2 x 2 m

Chinle Chert	1
Petrified Wood	1

Note: Windes and Cameron (1981) sampled Upper Kin Klizhin for lithic material. Their results indicate that Washington Pass and Chinle chert occur in low frequencies while the assemblage is dominated by white chalcedonic wood, a material which is presumed to be locally derived.
Ground Stone: No ground stone artifacts were noted.
Articulation with the Roadway: The Upper Kin Klizhin Ruin is set apart from the South Road by approximately 150 m and is connected to that roadway via a spur which is visible on the ground. The spur is evidenced by a shallow swale approximately 6 m in width visible to the west and northwest for a short distance as it tops the crest of the low ridge on which Upper Kin Klizhin rests. An additional alignment for a spur connecting Upper Kin Klizhin with Casa Patricio is suggested by Powers, Lekson and Gillespie 1977 and might represent the Rincon Road. This would be a reasonable route for this feature but ground documentation and imagery analysis have not yet verified this alignment.
Site Condition: Upper Kin Klizhin is reduced to a substantial rubble mound which is stable. Portions of the veneer have fallen away from the base of the exposed west wall of the tower kiva. This may represent an attempted "tunnel" into the kiva by looters in the past.

★

Site Name: Casa Patricio
LA Number: 34208
Other Numbers: CRP Field No. S-1
Recorder: John R. Stein, Daisy F. Levine, David Simons
References: Loose and Grigg (1981) National Register Nomination
Temporal Affinity: Marshall: 850-1000 AD; Weighted Ceramic: 791-921 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Site is located at the probable intersection of the South Road and Rincon Road.
Topographic Situation: Site is situated on a gentle slope beneath the sandstone caprock of a small mesita 900 m south of Kin Klizhin Wash.
Visible Horizon: Although located in an elevated situation above the Kin Klizhin Valley, visibility from this location is restricted. Mesita de la Junta, however, is clearly visible.
Soil Structure: Sandy loam
Vegetation: Range grassland with trace of saltbush
Primary Drainage: Kin Klizhin Wash
Elevation: 6380'
Site Description: The name "Casa Patricio" refers primarily to a great kiva and attendant rooms and middens (see Figure C-12). The general site area, however, appears to have been re-used at or around the turn of the century. Analysis of the imagery for this area suggests the South Road enters the site area via a notch in the caprock above and to the north of the site. A swale-like feature can be seen skirting the kiva from the notch.
Structural Remains: Casa Patricio consists of a small great kiva evidenced by a depression 12.5 m in diameter and approximately 1 m in depth. The structure was apparently semisubterranean in character with three alcoves, evidenced by mounds standing 1.5 m from the present surface of the kiva center. Two of them were constructed on opposing sides of the kiva on a 75-255 degree

axis. Partial wall alignments are visible suggesting that the rooms are keyhole-shaped and roughly 4 x 2 m in interior dimensions. A third alcove is situated on a 345-degree bearing from the kiva center and is much more massive in character than the east and west alcoves. Although largely obscured by rubble, this alcove measures 6 x 3 m in interior dimensions and is backed by a mound towering up to 3 m above the present floor of the kiva depression. The wall alignments are confusing; however, it might be said with some certainty that the alcove is the major construction within the rubble mass and that it is backed to the north by a large platform. A retaining wall extends from this platform for a distance of approximately 11 m to form a contiguous enclosure open to the south. Upright slabs located within this enclosure suggest both the presence of a slab-based jacal curtain wall and several slab-lined hearth boxes, one of which is an elongated feature .5 m in width and 2 m in length. This area is reminiscent of a similar situation at Bis'a'ani where numerous hearths were superimposed on a platform between kivas (Marshall and Doyel 1981). Marshall speculates that these features represent the kitchen where food products are prepared and taken into the kiva (1982: personal communication).

Masonry: Casa Patricio is constructed of coursed dark brown indurated sandstone slabs and blocks. Wall alignments are poorly visible; however, the mass of the mound and occasional exposed segments indicate that walls were of compound to core-and-veneer construction. Estimated wall thickness averages .5 m. Some shaping by scabbling is apparent within the rubble. As discussed above, upright blocks and slabs were noted in the northeastern area of the site. These features may represent either the remnants of slab boxes or jacal construction within the structural matrix. Average element size utilized in the construction of Casa Patricio is .30 x .20 x .05 m.

Middens: These are to the west, south and east of Casa Patricio and exhibit dense deposition of cultural material. The bulk of the midden deposition, however, exists in two midden mounds immediately south and east of the kiva depression. Midden No. 1, the south midden, measures approximately 25 x 20 m and may be as deep as 2 m. The surface of this midden is characterized by the presence of large slabs, numerous spalls and dense ceramic and lithic debris. Midden No. 2 is adjacent to Midden No. 1 to the northeast. This also is a large midden and may measure as large as 35 x 25 m. Depth of this midden approaches 2 m. Like Midden No. 1, this midden is also characterized by the presence of large slabs, spalls and dense lithic and ceramic debris. This midden surface also exhibits a slab-lined hearth and masonry/spall concentrations which may indicate the presence of structural remains.

Material Culture: Ceramics

Midden No. 1: 2 x 2 m

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Plain (coarse temper)	6	1	75	82
Plain (fine temper)	1		1	2
Cibola Wide Banded	1			1
Corrugated: Medicine Style	1			1
Corrugated: Tusayan Style	2			2
Cibola White Ware				
Undiagnostic	3			3
La Plata B/W	1			1
Red Mesa B/W	4	2		6
Gallup B/W	1			1
TOTAL:				99

Midden No. 2: 2 x 2 m

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Plain (coarse temper)	3		44	47
Plain (fine temper)	2	2		4
Wide Banded	4			4
Narrow Banded (unsmoothed)	1			1
Narrow Banded (smoothed)	1			1
Corrugated: Medicine Style	5			5
Corrugated: Tusayan Style	5			5
Cibola White Ware	10	1	2	13
Undiagnostic				
La Plata B/W	3	3		6
Red Mesa B/W	2	3		5
Escavada B/W	1			1
Gallup B/W	3			3
Mesa Verde White Ware				
McElmo B/W		2		2
White Mountain Red Ware				
Undiagnostic			1	1
TOTAL:				98
TOTAL CERAMICS:				197

Material Culture: Lithics
Midden No. 1: 2 x 2 m sample

Chinle Chert	3
Miscellaneous Chalcedony	5
Petrified Wood	1
Quartzite	1
TOTAL:	10

Midden No. 2: 2 x 2 m sample

Miscellaneous	3
Petrified Wood	4
Quartzite	1
Red Dog Shale (pendant)	1
Hammerstone (petrified wood)	1
TOTAL:	10
TOTAL LITHIC:	20

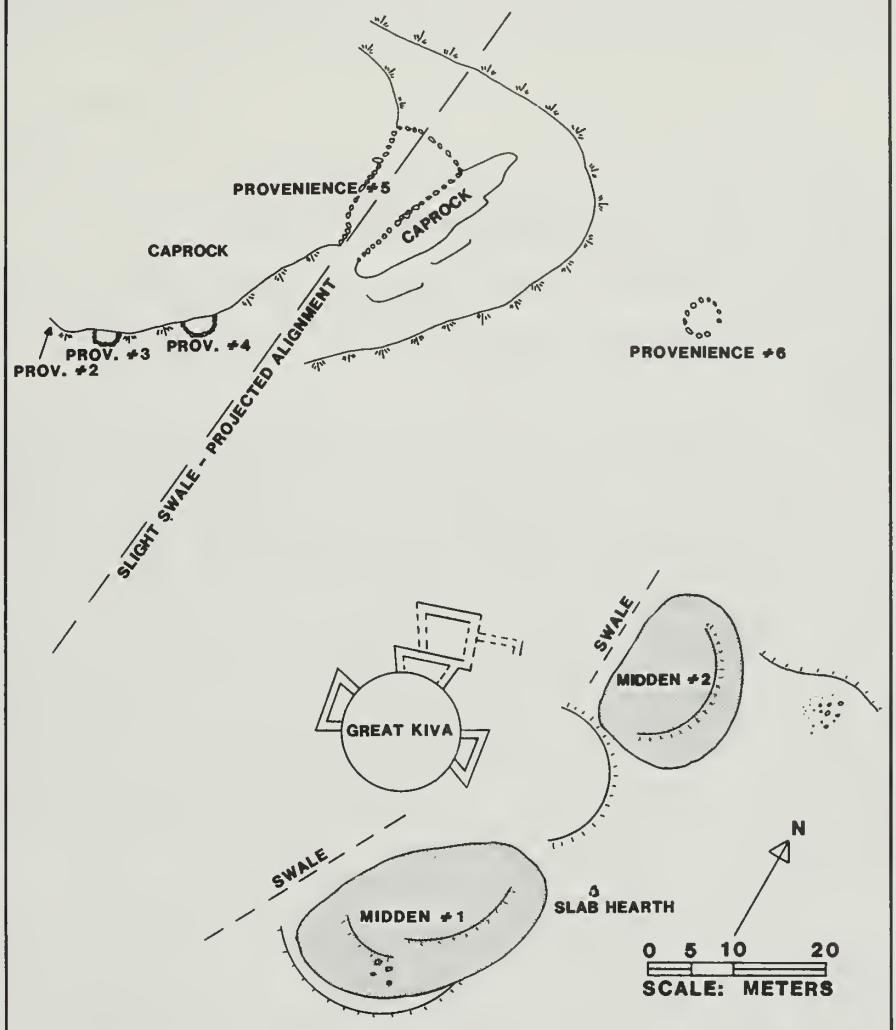
Material Culture: Ground Stone
Total in site area

Sandstone Two-Hand Mano	3
Quartzitic Sandstone	
One-Hand Mano	1
Deep Trough Metate	2
Basin Metate	1
TOTAL:	7

Historic Material: Historic material within the site area was extremely sparse. One UMC. 44-40 cartridge was located within Provenience No. 5. An aqua turn-of-the-century beer bottle (seam over closure) was stashed in Provenience No. 6.
Provenience Discussions: The following is a discussion of other cultural remains in the immediate area of Casa Patricio. Although one cannot be absolutely certain, it is presumed, based on the state of reduction, type of construction, etc., that the following are all turn-of-the-century herding manifestations. It should be noted, however, that the possibility exists, particularly with reference to Provenience No. 6, that Anasazi structural remains may be represented. Provenience No. 1 is Casa Patricio itself.
Provenience No. 2: This provenience is a petroglyph consisting of a name carved in excellent handwriting with a flourish. Unfortunately, the name could not be easily be made out: "...dad Fboriera (?) El Rito, NM...1901." The sandstone is soft here and the inscription is somewhat eroded.
Provenience No. 3: This provenience consists of a semicircular to subrectangular enclosure backed up against the sandstone caprock ledge which forms the top of the mesita. The interior dimensions of the structure are roughly 2.5 x 2.5 m in width with an apparent entry at 110 degrees from the center of the back wall. Construction appears to have been coursed masonry on a foundation of very large sandstone blocks (the largest being 1.2 x .45 x .45 m). These blocks were unshaped and are now highly weathered. Rubble from the superstructure is not seemingly sufficient to form a full height wall. The structure interior is now filled with cow dung. No associated material culture was noted.
Provenience No. 4: This provenience is located 10 m and 230 degrees from Provenience No. 3 along the same sandstone ledge. This feature is similar in shape and construction to Provenience No. 3 exhibiting massive foundation elements and a coursed masonry superstructure. Interior dimensions of the structure are measured at 3 x 3.5 m. Coursed masonry elements of tabular dark sandstone measure up to .50 x .50 x .30 m and walls are standing to 1 m. An apparent entry way is located 90 degrees from the center of the rear wall. Relief of the ledge at this point is 2 m.
This structure is almost certainly historic, however, there is no definitely associated material culture.
Provenience No. 5: This provenience consists of a dry stacked masonry corral which utilizes a natural break in the sandstone bedrock cap of the mesa top. Location of this feature is 28 m and 20 degrees from Provenience No. 4 and 325 degrees and 50 m from the center of the great kiva. The corral is bottle shaped about 15 m in length and 10 m in maximum width.
The natural walls of the sandstone enclosure (1.5 m in relief) are enhanced by the addition of dry stacked masonry. Element size varies; angular blocks range to .75 x .4 x .3 m. This structure has not been used as a corral for some time. Associated material consists of a UMC 44-40 cartridge.
Comment: Provenience No. 5, according to the imagery, "blocks" the upper prehistoric access to Casa Patricio. Referring to the map is certainly the least confusing alternative to describing the relationship of Provenience No. 5 and the prehistoric lineament.
Provenience No. 6: This provenience is located below and 30 m east of Provenience No. 5 and downslope 55 m north of the great kiva, on a gentle sandy slope. The provenience consists of

FIGURE C-12

CASA PATRICIO LA 34208



a circular structure 4 m in interior diameter. Structural remains consist of large unshaped foundation elements up to 1 m in length. These are of soft sandstone and are currently very weathered. Large boulder elements and upright blocks are incorporated into the structural matrix. At its maximum the wall stands only 2 courses. The entrance is at 80 degrees from the center of the structure. There is a turn-of-the-century aqua bottle stashed in a cavity of the wall, and a single prehistoric sherd present. Although extremely reduced, there is no evidence for ash mounds, trash scatter, etc. This structure is presumed to be historic.

Historic Discussion: The historic component of the Casa Patricio area consists of four structures and an inscription. One structure (Provenience No. 5) appears to be a hogan. Provenience Nos. 2 and 3 may represent shelters and pens. Roofing/superstructure characteristics of the structures are not known. The remains suggest a limited occupation.

Prehistoric Discussion: Casa Patricio represents an early great kiva dating to the late PI early PII period (850 to 1,000 AD), although a trace of later material is present. Small in size for an early great kiva, it displays the characteristics of a great kiva including semi-

subterranean construction, surface alcoves and large alcove/roomblock on the northern axis. Casa Patricio is directly articulated with the South Road.
Swales: Three distinct swales can be seen in the area of Casa Patricio. One, as mentioned earlier, cuts 30 m west of the great kiva and enters the area through a notch in the mesa caprock. Two other swales apparently represent a path or road which enters the site area at 30 degrees, passes directly beneath the kiva to the east, changes angle, and leaves the area on a bearing of 60 degrees. In all, only about 70 m of swale can be discerned on the ground. Of this total, most is indistinct, shallow and not easily identified.

★

Site Name: Lower Greenlee Ruin
LA Number: 35419
Recorder: William Kight, John R. Stein, Dabney Ford, Daisy F. Levine
Temporal Affinity: Marshall: 950-1125 AD; Weighted Ceramic: 810-1017 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Southeast Road
Topographic Situation: Structure is located at the base of a low mesa flanking an unnamed lateral to Fajada Wash.
Visible Horizon: Points along face of Chacra Mesa, Red Mountain, and Greenlee Ruin
Vegetation: Grassland with trace of saltbush
Primary Drainage: Unnamed lateral to Fajada Wash
Elevation: 6335'
Site Description: The site consists of a massive rubble mound at the base of the mesa, 117 degrees and 350 m from Greenlee Ruin (see Figure C-13). The masonry structure is reduced to rounded contours and definition of walls is difficult. The house appears to be terraced from an eastern orientation to a maximum mound relief of 3.5 m on the western margin of the rubble mound. This elevation is attained within a rectangular cell measuring 6 x 6 m in interior dimensions. Judging by the amount of fallen wall this feature must have been of multi-story construction. The placement, elevation and size of this feature suggest the presence of a tower kiva. To the east of the tower kiva is a plaza, the overall dimensions of which are 19 m NS x 12 m EW. The plaza surface is elevated approximately 1 m above present ground surface and probably contains a large semi-subterranean kiva estimated at 7 m in diameter. Flanking the plaza to the north and partially contiguous with the tower kiva is a crescent of three contiguous rooms 2.5 m in width and 3.25 m in length. These rooms may form a northern alcove to a large plaza kiva. Structural remains to the south and southwest of the plaza have been obscured by rubble and cannot be defined at this time. Portions of a retaining wall immediately below the plaza indicate that the entire structure was constructed atop an artificial masonry platform.
Masonry: Visible wall fall and obvious mass of the rubble mound indicate that walls were constructed in the core-and-veneer style. Masonry elements are of dark brown indurated sandstone and average .35 x .20 x .03 m in size. There is no evidence for modification of the elements.
Rooms: As discussed above only 4 rooms can be defined from the present surface. Additional rooms may be present to the southwest of the plaza area.
Kivas: Although alignments are obscured by rubble, 2 possible kivas may exist within the structural matrix of the ruin. The location of these kivas is discussed above.
Plaza: Actual configuration of the plaza appears to be rectangular with the east wall and portions of the north and south walls well defined. Uncharacteristic of Bonito Style architecture, however, is the superimposition of an "arc" of surface rooms over the plaza surface. Again, additional features may be obscured to the south-southwest of the plaza area.
Platform: Remnants of a low masonry wall are visible within the outer perimeter of the rubble mass. Configuration of the rubble mound suggests that this wall is the remains of a substantial artificial platform, on which the structure was constructed.
Associated Middens: A formal midden 25.0 m x 19.0 m is located 6.0 m east of the rubble mound. Depth of the midden is estimated at .5 m. Artifact density on the midden surface is over 50 pieces per square meter. A 2 x 2 m sample area was recorded in the midden.
Material Culture: Ceramics

Cibola Plain (large sand temper but not Lino)	51
Cibola Clapboard	5
Cibola Narrow Banded	9
Cibola Corrugated Indented	34
Chuska Corrugated Indented	6

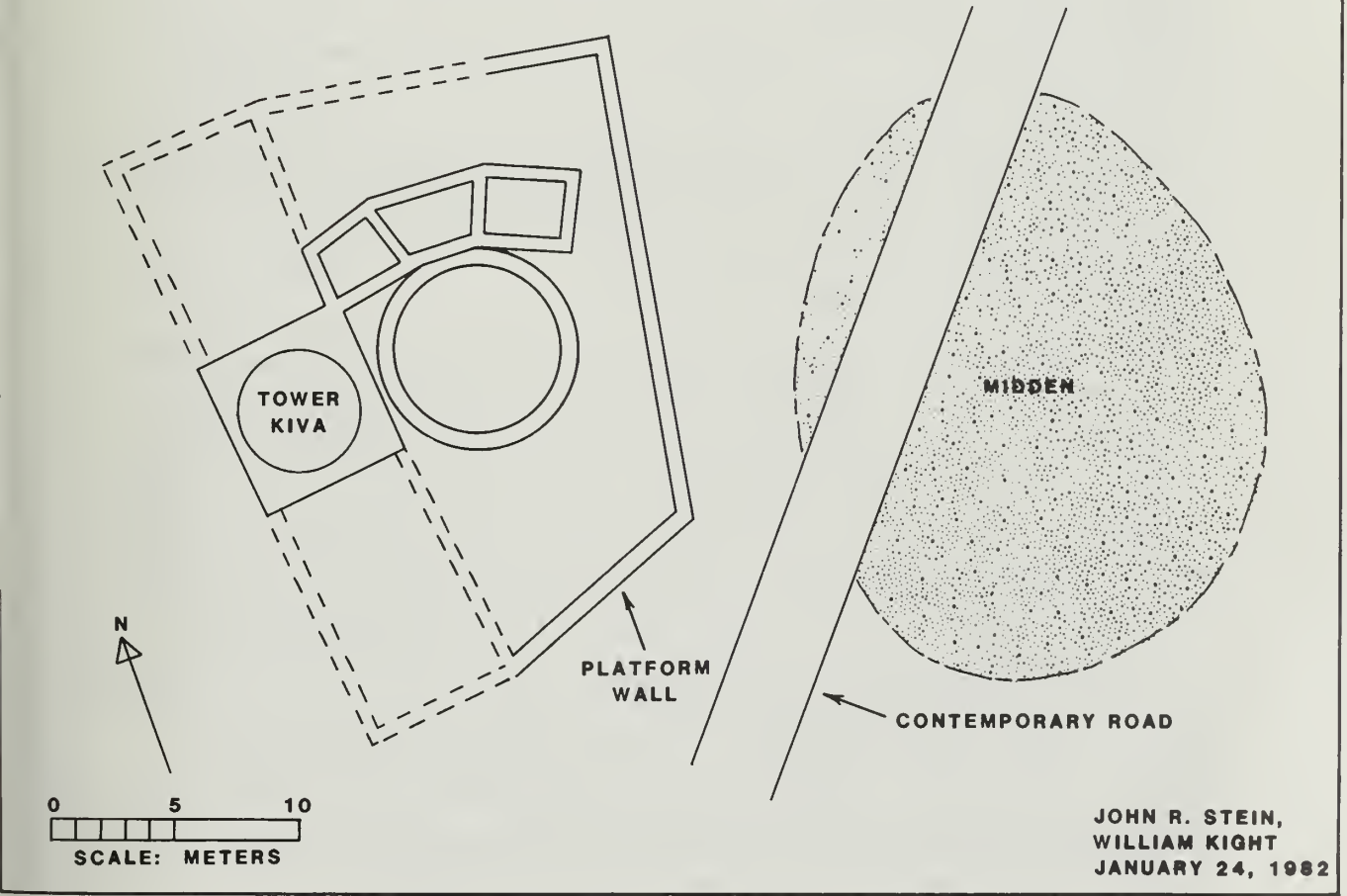
	Jar	Bowl	Indeterminate	Total
Red Mesa B/W	19	13		32
Solid Style B/W	1	7		8
Gallup Style B/W	11			11
San Juan Mancos B/W	1			1
McElmo B/W	1			1

Slipped Body Sherds	6	5	11
Indeterminate Mineral			
Painted B/W	8	1	9
Tsegi Orange Ware		1	1
White Mountain Red Ware			
Wingate Style		1	1
TOTAL:			75

Material Culture: Lithics
2 x 2 m Sample

Chinle Chert (1072)	2
Red Dog Shale	1

FIGURE C-13
LOWER GREENLEE RUIN LA 35419



Grab Sample: (total midden surface)

Washington Pass Chert	2	
Chinle Chert	8	
Butterscotch Chert	1	
Fossiliferous Chert	2	
Dark Petrified Wood	7	(includes one fist-sized hammerstone)
Light Petrified Wood	4	
White, Waxy Petrified Wood	4	(includes one undiagnostic biface)
Quartzite	1	
Red Dog Shale	1	
TOTAL:	30	

Ground Stone: None observed
Midden Surface: Numerous slabs and burned spalls are present.
Articulation with the Roadway: The projected alignment of the Southeast Road passes 150 m west of the structure.
Site Condition: This site is naturally reduced and stable. A contemporary two-track primitive road cuts across the midden just east of the base of the plaza. As oil and gas exploration is increasing in this area, widening this road could endanger the site.
Comments: The apparent construction of this structure upon a platform is not a common aspect of Bonito Style architecture. Presence of the platform-tower kiva combination makes Lower Greenlee a very significant location. The relationship of Lower Greenlee to Greenlee remains to be investigated. Although Lower Greenlee is the older of the two structures, being roughly coincident with the establishment of Upper Kin Klizhin, use of the structure likely persisted to the end of the Chaco sequence.

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Site Name: Greenlee Ruin
LA Number: 35418
Recorder: John R. Stein, Ann Nolin
References: Powers, Gillespie and Lekson 1983; Windes and Cameron (1981)
Temporal Affinity: 1090-1130 AD (Windes and Cameron 1981); Marshall: 1000-1125 AD; Weighted Ceramic: 899-1116 AD.
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Southeast Road
Topographic Situation: The site is situated at the crest of a sandy ridge overlooking the confluence of two unnamed laterals of the Fajada Wash which enter the Fajada 5 km to the north. The elevated position of the Greenlee building affords it a panoramic view of the Fajada drainage and the Chacra Face. Likewise, the site can be seen from a distance.
Visible Horizon: Fajada Butte, Fajada Gap, Red Mountain and the tip of Mount Taylor
Soil Structure: Sand
Vegetation: Grasses, saltbush, snakeweed and wolfberry
Primary Drainage: Unnamed lateral to the Fajada Wash
Elevation: 6380'
Site Description: The Greenlee Ruin consists of a Bonito Style structure basically rectangular in shape, containing 18 rooms and one surface housed kiva (see Figure C-14). Maximum dimensions of the mound are 18 x 19 m. Walls remain standing in the ruin to a height of 2.85 m. An additional 1 m of rubble is estimated to the original ground surface. Mound relief is generally uniform throughout the site area suggesting that the entire structure was one story. There is no evidence that the northern row of rooms was terraced above the courtyard created by the roof of the kiva. Rather, it appears that the roofs of the rooms were a continuation of that surface.
Masonry: The Greenlee house is constructed of tabular dark brown dense sandstone slabs and bocks averaging .3 x .3 x .05 m in size. Some banding is evident in exposed wall sections. No evidence for pecking or scabbling was noted. The masonry elements are incorporated into massive walls of core-and-veneer construction. Width of the walls ranges from .5 to .85 m.
Rooms: Eighteen rooms were defined during mapping of the Greenlee house. The rooms are arranged in a series of 3 rows of 4 rooms each, backing the kiva to the north. The central "core" of 4 rooms immediately north of the kiva may have originally been integrated into the kiva housing. The rear, or northernmost, row of rooms and the rooms flanking the housing to the east and west may be later additions. Interior room dimensions range from 4 x 4 m to 2 x 2.5 m. Wall alignments are clearly visible and rooms can be easily defined.
Kivas: A single housed kiva is incorporated into the room block on the southern margin of the ruin. Diameter of the kiva measures 6.9 m. Portions of the contact between the kiva and housing wall can be seen in the rubble.
Plaza: No formal plaza is evident at Greenlee Ruin. Spall middens located to the south and west of the house block may have formed an informal plaza enclosure.
Associated Middens: No formal midden appears to be associated with the Greenlee Ruin. A thin scatter of ceramic and lithic debris is located in a 20 x 20 m area 12 m south of the southeast corner of the house block. This scatter appears to be surficial in nature.

Construction Middens: Three conspicuous mounds of construction detritus, or spall middens, are located roughly 10 m to the south and west of the house block. These middens are composed of masonry debris from construction and are devoid of cultural material.
Spall Midden No. 1: Located 8 m and 255 degrees from the southwest corner of the roomblock, this midden measures 8 x 8 m. Estimated depth of the midden is .5 to .75 m.
Spall Midden No. 2: Located 200 degrees and 8 m from the southwest corner of the roomblock, this midden measures 10 x 7 m. Estimated depth is .5 to .75 m.
Spall Midden No. 3: Located 150 degrees and 10 m from the southwest corner of the roomblock, this midden measures 5 x 9 m. Estimated depth of the midden is .5 to .75 m.
General Spall Scatter: There is general scatter of construction waste flanking the roomblock to the west and northwest. This scatter is approximately 10 m distant from the roomblock and is surficial in nature.
Material Culture: Ceramics
Only a thin scatter of material exists in the vicinity of Greenlee Ruin. The following sample represents around 75 percent of the ceramic debris within a 20 x 20 m area 130 degrees and 18 m from the southwest corner of the house block.

Cibola Corrugated Indented	30			
Chuska Corrugated Indented	1			
Cibola Plain	3			
Cibola Narrow Banded	8			
Cibola Wide Banded	1			
Red Mesa B/W	Bowl: 1		Jar: 2	
Escavada B/W			1	
McElmo B/W	2			
Socorro B/W			1	
Gallup Style, carbon paint with trachyte temper:		1 bowl		
TOTAL: 52				

Results of Ceramic talley (Windes and Cameron 1981):

	Jar	Bowl	Indet.	Total
Cibola Utility Ware				
Plain				
Narrow Neck-banded	6			6
Neck-indented Corrugated	1			1
Indented Corrugated	89			89
Cibola White Ware				
Red Mesa B/W	2	1		3
Puerco B/W	2			2
Gallup B/W	5	2		7
Chaco-McElmo B/W	1	1		2
Undifferentiated	4	5		9
Undifferentiated White Ware	18	11		29
Chuska Utility Ware				
Plain	1			1
Indented Corrugated	4			4
Chuska White Ware				
Chuska B/W		1		1
Toadlena B/W		1		1
White Mountain Red Ware				
Undifferentiated		2		2
Puerco B/R	1			1
Other				
Forestdale Smudged		1		1
TOTAL:				164

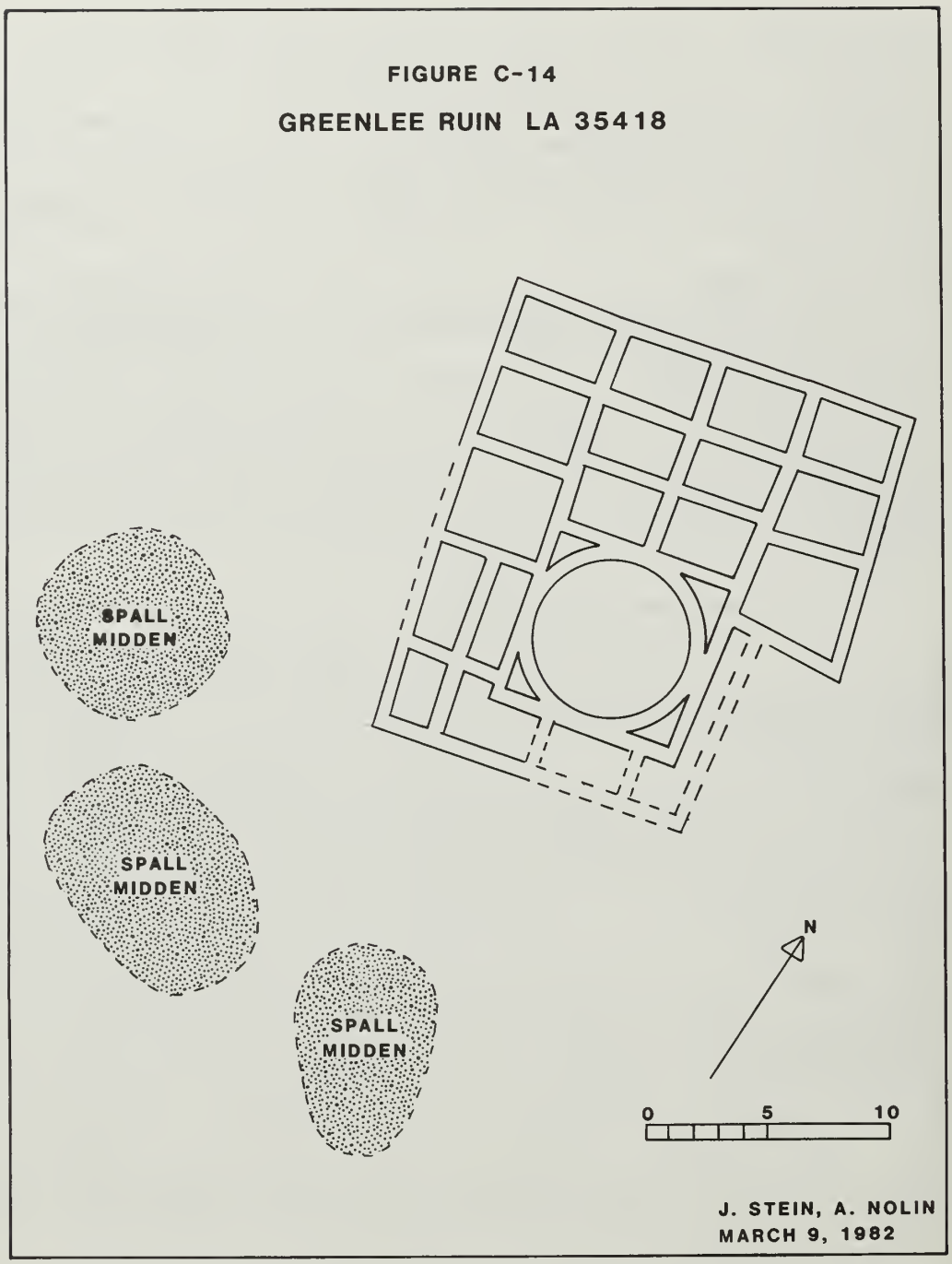
Material Culture: Lithics
Lithic debris was extremely sparse in the site area. Pieces recorded represent the total amount observed.

Washington Pass Chert	1
White Petrified Wood	1

Results of Lithic Tally (Windes and Cameron 1981): Windes and Cameron were able to locate 22 lithic pieces in the vicinity of the Greenlee Ruin. Fifty-four percent of the material was Chinle chert and 4.5 percent was Washington Pass chert. The percentage of Chinle chert is much higher than frequencies in Chaco Canyon for the same period (Windes and Cameron 1981:2).
Articulation with the Roadway: As the Southeast Road is imaged it passes immediately east of the Greenlee Ruin. The nature of the articulation is not known.
Site Condition: Condition of the Greenlee Ruin is excellent (Stein 1978) with walls standing to virtually their full original height. Exposed surfaces of the walls are deteriorating, however, and stabilization is recommended.

FIGURE C-14

GREENLEE RUIN LA 35418



Comments: Greenlee Ruin is located near an imaged roadway (Obenauf 1980a:68) referred to as the Southeast Road. This roadway enters Chaco Canyon through Fajada Gap. Tom Windes (Windes and Cameron 1981:3) notes that western ceramics and Washington Pass chert comprise a minor percentage of the material at Greenlee. In contrast, Chinle chert, which has a southern source, represents over 50 percent of the lithic assemblage, suggesting that material is going into but not coming back out of Chaco Canyon (Windes and Cameron 1981:3). Windes dates Greenlee Ruin at 1090 to 1130 AD based on the ceramic sample presented here. The 1090 AD date represents a terminal date for Red Mesa B/W and the end date of 1130 AD was derived from the presence of late ceramic types such as Chaco-McElmo and White Mountain Red Ware (Windes and Cameron 1981:2).

★

Site Name: Chacra Face Ruin
LA Number: 35420
Other Numbers: Marshall and Kight Field Nos. 19 and 20
Recorders: Mike Marshall, William Kight
Temporal Affinity: Marshall: 950-1125 AD; Weighted Ceramic: 967-1126 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Chacra Face Road
Topographic Situation: The structures are located in virtually flat terrain at the foot of the scarp of Chacra Mesa, roughly 800 m south of the cliff face and 600 m north of Fajada Wash.
Vegetation: Grassland
Drainage: Fajada Wash
Elevation: 6260'
Site Description: Chacra Face Ruin consists of two non-contiguous structures reduced to rubble mounds with rounded contours (see Figure C-15). Relief of the mounds and mass of the rubble suggests Bonito Style architecture, although specific information pertaining to wall construction and alignment was not obtainable due to the advanced state of reduction.
House No. 1: This structure is "U"-shaped and measures 9 x 12 m. Maximum elevation of the mound is 1.5 m indicating single story construction. The structure is oriented to the northeast, and does not appear to contain a housed kiva within the block.
House No. 2: This structure is located 30 m southwest of House No. 1. It is "L"-shaped and is estimated to contain 10 rooms and a housed kiva. It is somewhat more massive than House No. 1 with mound relief approaching 2 m. Maximum structural dimensions are 20 x 26 m; mass of the mound suggests either compound or rubble-core masonry.
Associated Middens:
House No. 1: Midden No. 1: This midden is located 10 m to the northeast of the mound, and measures 12 x 17 m. Depth of deposition is estimated at .25 m. Midden No. 2: This midden is located immediately north of the house, and measures 10 x 12 m. Depth of deposition is estimated at .10 m. Midden No. 3: This midden is located 8 m west of the house and may be associated with House No. 2. It measures 12 x 10 m; depth of deposition is estimated at .25 m.
House No. 2: Midden No. 1: This midden is located 12 m southeast of the house. It measures 20 x 25 m; depth of deposition is estimated at .50 to .75 m. Cultural material density is high; slabs and possible structural remains are present. Midden No. 2: This midden is located south of the house approximately 8 m. It measures 14 x 14 m; depth of deposition is estimated at .5 m. There is a moderate cultural material density; burned slabs are present in addition to occasional masonry elements. Midden No. 3: This midden is located adjacent to the house on the west. It measures 25 x 5 m; depth of deposition is estimated at .25 m.
Material Culture: Ceramics
House No. 1: Sample taken from area adjacent to the mound at the west

Cibola Plain	5
Corrugated Indented	23
Cibola Banded	2
Unidentified White Ware	27
Red Mesa B/W	6
Escavada B/W	3
Gallup B/W	5
White Mountain Red Ware	
Puerco B/R	1
TOTAL:	72

House No. 2: Sample taken from Midden No. 1

Cibola Plain	13
Cibola Corrugated	19
Chuska Corrugated	2
Unidentified White Ware	7
Red Mesa B/W	10
Gallup B/W	7
White Mountain Red Ware	
Unidentified	1
Puerco B/R	1
Wingate B/R	1
San Juan Red Wares	
Unidentified Broad Line	1
Sanostee B/R	1
TOTAL:	63

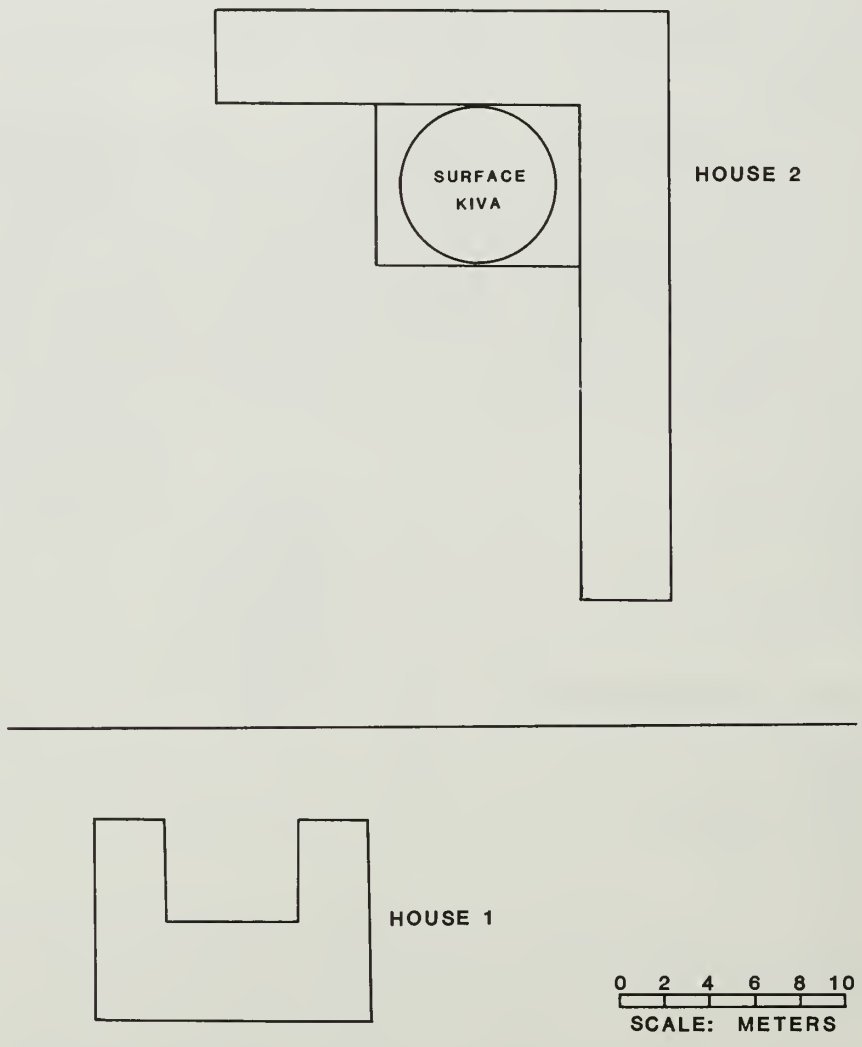
(No information was available on jar:bowl counts or on lithic or ground stone assemblages.)
Articulation with the Roadway: These two structures are located very near the imaged Chacra Face Road. Mike Marshall and Bill Kight, who located this site during reconnaissance survey, felt there was a distinct possibility that the road passed between the two roomblocks. This cannot be demonstrated until more intensive survey of the road alignment has been accomplished.

Comments: These two structures were recorded during a rapid reconnaissance of the Fajada Wash area of the Chacra Face Road by Mike Marshall and Bill Kight during December of 1981. In all, 26 sites were recorded along the foot of the Chacra Mesa scarp between Fajada Gap and Red Mountain, including the Chacra Face Ruin, Tse Lichii and Tse La Vie. Chacra Face Ruin was felt to represent Bonito Style architecture due to the mass of the rubble mounds, probable presence of a housed kiva, close proximity to the prehistoric road alignment and the presence of multiple midden formations. Care should be exercised, however, in considering Chacra Face Ruin as Bonito Style structure pending a more thorough investigation of architectural variation in the southern quadrant of the San Juan Basin during the late eleventh and early

FIGURE C-15

CHACRA FACE RUIN

LA 35420



M. MARSHALL & W. KIGHT
DECEMBER 1981

twelfth centuries. Worthy of note is small-house architecture such as that documented for Como Huevo (LA 36727) and other similar ruins of small residential structures in the vicinity of Greenlee Ruin. In a reduced condition these structures could easily pass for Bonito Style construction as they are fairly large (5-15 rooms), incorporate plazas into the structural matrix, and utilize massive compound and occasionally rubble-core masonry. However, unlike Bonito Style structures, they lack surface housed kivas incorporated into the roomblock, are arranged so as to suggest a residential pattern, generally lack multiple midden formations, are consistently oriented to the south-southeast, show no evidence for multi-story construction, and are not patterned with respect to imaged prehistoric roadways.

★

Site Name: Tse Lichii (Red Mountain Ruin)
LA Number: 35421
Recorder: John R. Stein, John Roney, Daisy F. Levine
Temporal Affinity: Marshall: 1050-1125 AD; Weighted Ceramic: 1066-1154 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Chacra Face Road
Topographic Situation: This site is situated on a gentle slope 400 m south of the base of the Chacra Mesa and 800 m north of Fajada Wash.
Visible Horizon: Red Mountain is in the foreground; Hosta Butte is on the southern horizon. Visibility to north and east is restricted by Chacra Face.
Soil Structure: Sandy loam
Vegetation: Rice grass, saltbush, sand sage, prickly pear, wolfberry, winter fat
Primary Drainage: Fajada Wash
Elevation: 6390'
Site Description: The site consists of a Bonito Style structure, rectangular in layout, reduced to a massive rubble mound 20 m EW x 15 m NS (see Figure C-16). The structure is oriented south-southeast. Mound elevation ranges from 1 m on the south to 2 m on the north and suggests that the structure may have been terraced to the north.
Masonry: Core-and-veneer masonry is apparent. Walls average .5 m in width.
Rooms: Ten to 15 rooms are estimated. Interior room sizes range from 4 x 7 m to 2.5 x 3.0 m. Rooms surround a central kiva housing. The north roomblock was either multi-story or the ceiling height was exaggerated.
Kiva: An apparent kiva housing 8 x 10 m in interior dimension is centered in the structure. Although the kiva wall itself is not visible, a probable 6 m diameter kiva exists within the housing.
Plaza: No plaza is associated with this site.
Associated Middens: No formal midden deposition was noted in association with the structure. Documented material culture was recorded from the mound.
Material Culture: Ceramics

Sample from LA 35421 Site Form

Cibola Plain	2	McElmo B/W	8
Corrugated Indented	47	Chaco-McElmo	6
Chuska Corrugated	1	Unidentified McElmo	7
Red Mesa B/W	4	Nava B/W	1
Solid Style	4	Socorro B/W	1
Gallup Style	3	White Mountain Red Ware	2
Unidentified White Ware	15	Showlow Smudged	1

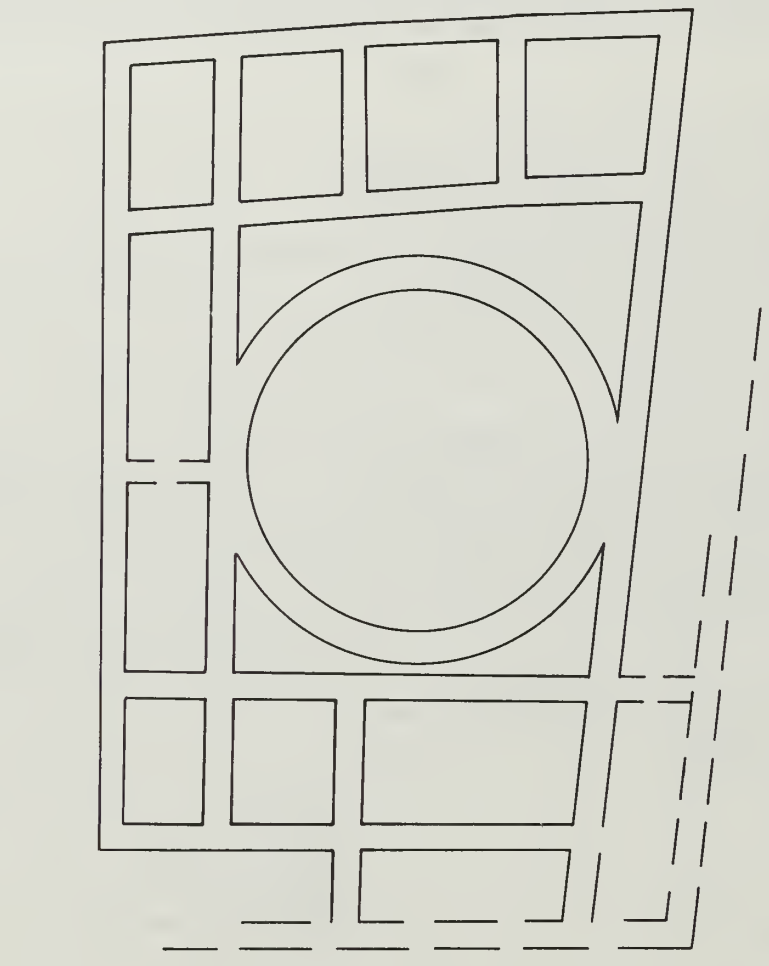
TOTAL: 102

Grab sample from house mound

	Jar	Bowl	Indeterminate
Cibola Grey Ware			
Plain (coarse temper)	1		1
Banded	1		
Corrugated (Medicine Style)	1		
Corrugated (Tusayan Style)	17		
Cibola White Ware			
Undiagnostic	6		
Escavada B/W	2	2	
Gallup B/W	1	1	1 (spindle whorl)
Carbon Painted White Ware			
McElmo B/W	3	6	
Chuska Grey Ware			
Corrugated (Hunter Style)	2		
Clapboard (Narrow)	1		
White Mountain Red Ware			
Undiagnostic		2	
Puerco B/R		1	
Wingate B/R		1	

FIGURE C-16

TSE LICHII LA 35421



J. STEIN, J. RONEY, D. F. LEVINE
JUNE 27, 1982

Material Culture: Lithics	
Sample from House Mound	
Petrified wood	3
Chinle Chert	1
Quartzite	1
Red Dog Shale	1
Mottled Chalcedony	1
Basalt	1

Articulation with the Roadway: Tse Lichii is located near the projected alignment of the Chacra Face Road. Actual location of the ruin with respect to the road is not now known.

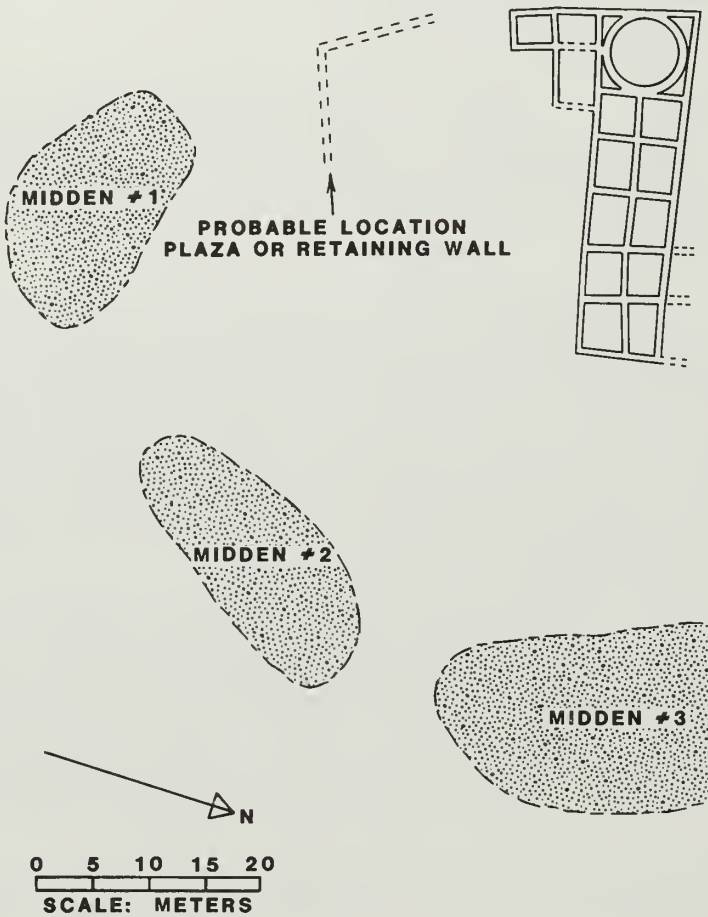
★

Site Name: Tse La Vie
LA Number: 35623
Other Number: Michael Marshall, William Kight Field No. 11
Recorder: John R. Stein, John Roney, Daisy F. Levine
Temporal Affinity: Marshall: 1050-1150 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Chacra Face Road
Topographic Situation: The ruin is situated 500 m southwest of the sheer face of Chacra Mesa and 400 m northeast of Fajada Wash. It is elevated somewhat above the floodplain of the Fajada Wash.
Visible Horizon: Visibility is restricted to the north by Chacra Mesa. Red Mountain stands in the foreground to the southeast 2.5 km distant. Hosta Butte can be seen on the southern horizon but is not prominent. Topographic features which flank Long Gap to Pueblo Pintado and Fajada Gap are visible although the passes themselves are not.
Soil Structure: Sandy loam
Vegetation: Range grasses, saltbush, and wolfberry
Primary Drainage: Fajada Wash
Elevation: 6360'
Site Description: Tse La Vie consists of a building of approximately 13 rooms (see Figure C-17). It is judged to be constructed in the Bonito architectural style by virtue of its massive walls resulting in exaggerated mound relief, the presence of multiple midden formations, a probable large kiva incorporated into the roomblock and its location on the projected alignment of the Chacra Face Road. The structure is constructed in an "L" shape and is oriented to the south. Maximum structural dimensions are 33 x 17 m. Mound relief is uniformly 3.25 m across the mound, suggesting either a multi-story structure or single-story structure with high ceilings.
Masonry: This structure consists of massive walls of core-and-veneer type masonry. Portions of the east-west walls are visible and range from .45 to .5 m in width. Masonry is of the McElmo Style and elements show evidence of having been shaped. Both dense tabular sandstone and blocks of soft friable sandstone have been utilized in construction. Weathering of the latter no doubt accelerated the reduction of the Tse La Vie roomblock.
Kivas: A room 7 x 9 m forms the northwest corner of the building. It is likely that a kiva 7 m in diameter is housed within this room. Although no additional kivas are visible from the surface it is very probable that a subterranean kiva exists to the south of the structure.
Plaza: A possible plaza enclosure measuring 18 x 32 m is suggested by a concentration of masonry elements south of the structure. This area is now covered by aeolian sands stabilized by a dense growth of wolfberry. It is very probable that a subterranean kiva may be located here.
Middens: Three discrete areas of midden deposition are apparent in the site vicinity.
Midden No. 1: This midden is located 32 m south and east of the roomblock and measures 22 m x 13 m. Depth of the deposition is estimated at .5 m. The midden surface is characterized by numerous slabs and spalls which are probably debris from construction of the roomblock. A possible masonry feature within the midden is suggested by a 2 x 2 m concentration of larger slab elements.
Midden No. 2: Midden No. 2 is located 14 m east of Midden No. 1, 29 m south and east of the roomblock. This midden measures 12 x 27 m and is estimated to be 1 m in depth. The presence of numerous tiny spalls on the midden surface indicates that construction debris may comprise a significant part of the midden content. Larger slab elements are absent from the surface of this midden.
Midden No. 3: Midden No. 3 measures 34 x 16 m and is located 25 m east of the roomblock. This midden also is composed of a significant amount of construction debris. Depth of the midden is estimated at 1 m. Large slabs on the midden surface suggest the presence of burials.
Material Culture: Ceramics
Midden No. 1: 2 x 2 m sample area
Midden No. 2: 2 x 2 m sample area
Midden No. 3: 2 x 2 m sample area
House Mound: Grab sample

	No. 1			No. 2			No. 3			House Mound		
	Jar	Bowl	Indet.	Jar	Bowl	Indet.	Jar	Bowl	Indet.	Jar	Bowl	Indet.
Cibola Grey Ware												
Plain (coarse temper)			19			4	2		1			2
Plain (fine temper)			12			2	1		2			7
Banded (wide)	1			2								
Banded (narrow)	6						4			1		
Corrugated												
Medicine Style	10			3			2			2		
Tusayan Style	50			40			23			24		

FIGURE C-17

TSE LA VIE LA 35623



J. R. STEIN, J. RONEY, D. F. LEVINE JUNE 26, 1982

	No. 1			No. 2			No. 3			House Mound		
	Jar	Bowl	Indet.	Jar	Bowl	Indet.	Jar	Bowl	Indet.	Jar	Bowl	Indet.
Cibola White Ware												
Undiagnostic	28			4	4	6	6		4	3	2	
La Plata B/W										1		
Red Mesa B/W				1	2			1		1		
Escavada B/W	13	1		11	3		4			4	2	
Gallup B/W	11	4		11	1		10	2		5	3	
Chaco B/W				1			2					
Chaco McElmo	2	5								5	11	
Mesa Verde White Ware												
McElmo B/W				3				1				
Chuska Grey Ware												
Plain			1	1								
Banded (narrow)	5			1								

Corrugated								
Exuberant	1							
Hunter Style	20		5		6		2	
Chuska White Ware								
Undiagnostic		2						
Gallup Style			2					
McElmo Style		1					1	
White Mountain Red Ware								
Undiagnostic		14			1			
Puerco B/R		1		2		2	3	2
Wingate B/R		2						
Socorro B/W	2						1	

Material Culture: Lithics

Midden No. 1:	2 x 2 m Sample	Grab Sample	Midden No. 2: 2 x 2 m Sample	Grab Sample
Petrified Wood	3	10	3	5
Chinle Chert	3	3		2
Washington Pass Chert	1			
Red Dog Shale		2	2	3
Quartzite		3		1
White Chert			1	
Miscellaneous Chert		2		1
Mottled Chalcedony		3		
Grants Obsidian			1	
Hammerstones				
Petrified Wood		1		1
Projectile Points				
Jemez Obsidian				
Brushy Basin Chert		1		
Ground Stone				
Sandstone Trough Metate				

Midden No. 3:	2 x 2 m Sample	Grab Sample	House Mound: Grab Sample
Petrified Wood	1	6	6
Chinle Chert		1	1
Washington Pass Chert		1	
Red Dog Shale	2	7	
Quartzite			4
White Chert			
Miscellaneous Chert		1	
Mottled Chalcedony	2		
Grants Obsidian			
Hammerstones			
Petrified Wood		3	
Projectile Points			
Jemez Obsidian			1
Brushy Basin Chert			
Ground Stone			
Sandstone Trough Metate		1	

★

Site Name: Greasy Hill Pueblo
LA Number: 42282
Other Numbers: Chaco Center Survey Number: 29 SJ 2282
Recorder: Robert Powers, Daisy Levine
References: Loose and Grigg (1981)
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: Pueblo Alto to Greasy Hill Road
Topographic Situation: The ruin is located 400 m south of the Escavada Wash, immediately above the floodplain. This location is due south of the confluence of the Escavada and the Betonnie Tsosie Washes.
Visible Horizon: Chaco North and Kin Indian Ruin.
Soil Structure: Sandy loam over clay substrate (hence the name Greasy Hill)
Vegetation: Grasses, snakeweed
Primary Drainage: Escavada Wash
Elevation: 6240'
Site Description: Greasy Hill consists of a Bonito Style structure 34 m EW x 23 m NS (see Figure C-18). Loose and Grigg (1981) show 6 rooms flanking a surface housed kiva. An apparent plaza is located to the east of the housed kiva and may conceal a fully subterranean kiva.
Masonry: The site is reduced to rounded countours but wall alignments are visible. Mound relief and visible walls suggest core-and-veneer construction.
Kivas: An elevated kiva 8 m in diameter is incorporated into the southwestern corner of the roomblock. An additional kiva of approximately 8 m in diameter is suggested by a visible depression in the plaza enclosure.
Plaza: A walled plaza 12 x 16 m in extent is articulated with and located south of the roomblock.
Associated Middens: No information is available on the character of the middens associated with Greasy Hill Ruin. Loose and Grigg (1981) show a large midden immediately south and west of the structure. Material culture samples recorded by Daisy Levine and Robert Powers were located on the house mound and in two areas south and east of the ruin.
Material Culture: Ceramics
Sample No. 1: 2 x 2 m area on slope east of ruin
Sample No. 2: 10 x 10 m grab sample on slope south of ruin
Sample No. 3: Grab sample from house mound

	Sample No. 1			Sample No. 2			Sample No. 3		
	Jar	Bowl	Indeterminate	Jar	Bowl	Indeterminate	Jar	Bowl	Indeterminate
Cibola Grey Ware									
Plain	6			2					
Corrugated	43			22					
Cibola White Ware									
Undiagnostic	2	1		3					
Red Mesa B/W							1		
Escavada B/W	3			3	1				
Gallup B/W	17	5		1	3		1		
Chaco B/W	1	1							
Chaco McElmo		1		3	1				
Chuska Grey Ware									
Corrugated	1			2					
Chuska White Ware									
Red Mesa Style				1					
White Mountain Red Ware									
Puerco B/R*								1	
Polished Smudged									
Brown Ware								1	
Carbon Paint									
Red Mesa Style								1	
Unidentified									
Carbon Paint								1	

*One Puerco B/R noted outside sample areas

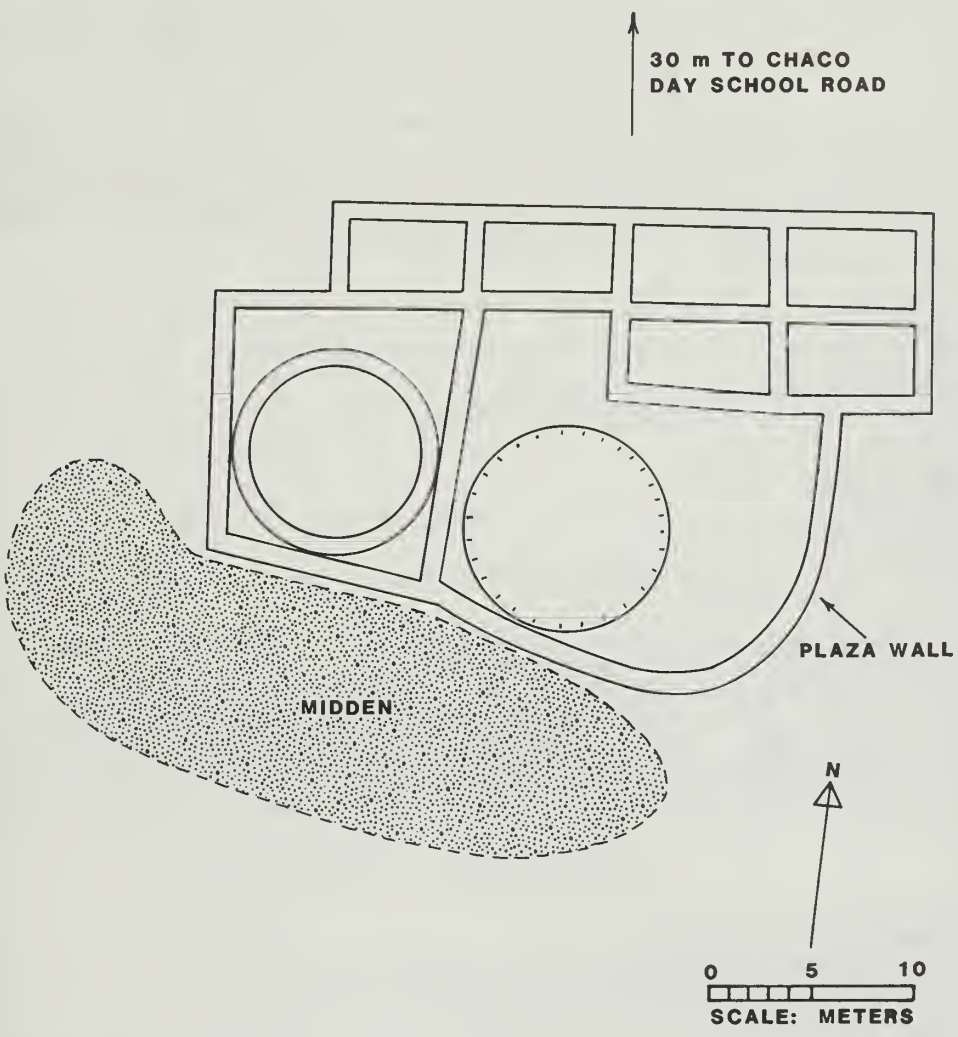
Material Culture: Lithics

Petrified Wood	12	4	

Articulation with the Roadway: Greasy Hill Ruin is clearly the terminus of a formalized roadway originating at Pueblo Alto (see Figure 4-3). The nature of the articulation of this roadway with the structure is not known.
Condition: At present Greasy Hill Pueblo is in good condition although a well-traveled county road cuts immediately north of the pueblo's rear wall. This road is scheduled to carry traffic into Chaco Canyon sometime during the coming year. Improvements such as widening could result in irreversible damage to Greasy Hill.

FIGURE C-18

GREASY HILL RUIN LA 42282



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Site Name: Kimbeto Point
LA Number: 35422
Recorder: Mike Marshall, Chris Kincaid
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: The site may be associated with a projected road originating at Pueblo Alto and bearing 26 degrees. Ultimate destination of the road may be this ruin, however it may also continue to points unknown.

Topographic Situation: The site is situated on the northwest margin of a low sandstone mesa 60 feet in elevation. The structure actually occupies the summit of a small knoll which exaggerates the prominence of the ruin and results in the most elevated situation to be found within the immediate region. Location of the ruin is 500 m north of the Kimbeto Wash and 2.8 km northeast of the confluence of the Kimbeto with the Escavada.
Visible Horizon: Marshall notes extended visibility from the site area. Pueblo Alto, Kin Indian Ruin, and the area known as Chaco North should be visible.
Primary Drainage: Kimbeto Wash
Elevation: 6240'
Site Description: Kimbeto Point consists of a single large rectangular room 4 x 5 m in interior dimensions. The structure is substantially reduced; however, partial alignments are visible. Position of the structure and the abundant rubble present exaggerate the mass of the structure and cause it to appear as a "cone" of masonry rubble from a distance. The size, location, and mass of the structure suggest that construction was consistent with the Bonito architectural style.
Masonry: Construction was of sandstone blocks and slabs .2 to .3 m in size. Masonry elements were incorporated into the walls in compound fashion to form walls averaging .40 m in thickness.
Associated Middens: A substantial deposit of midden debris exists on the east slope of the knoll directly adjacent to the structure in a 7 x 15 m area. Estimated depth is .5 m. A surficial scatter of artifactual materials exists within a 25 m NS by 30 m EW area. Abundant debris indicates an intensive occupation of short duration.
Material Culture: Ceramics

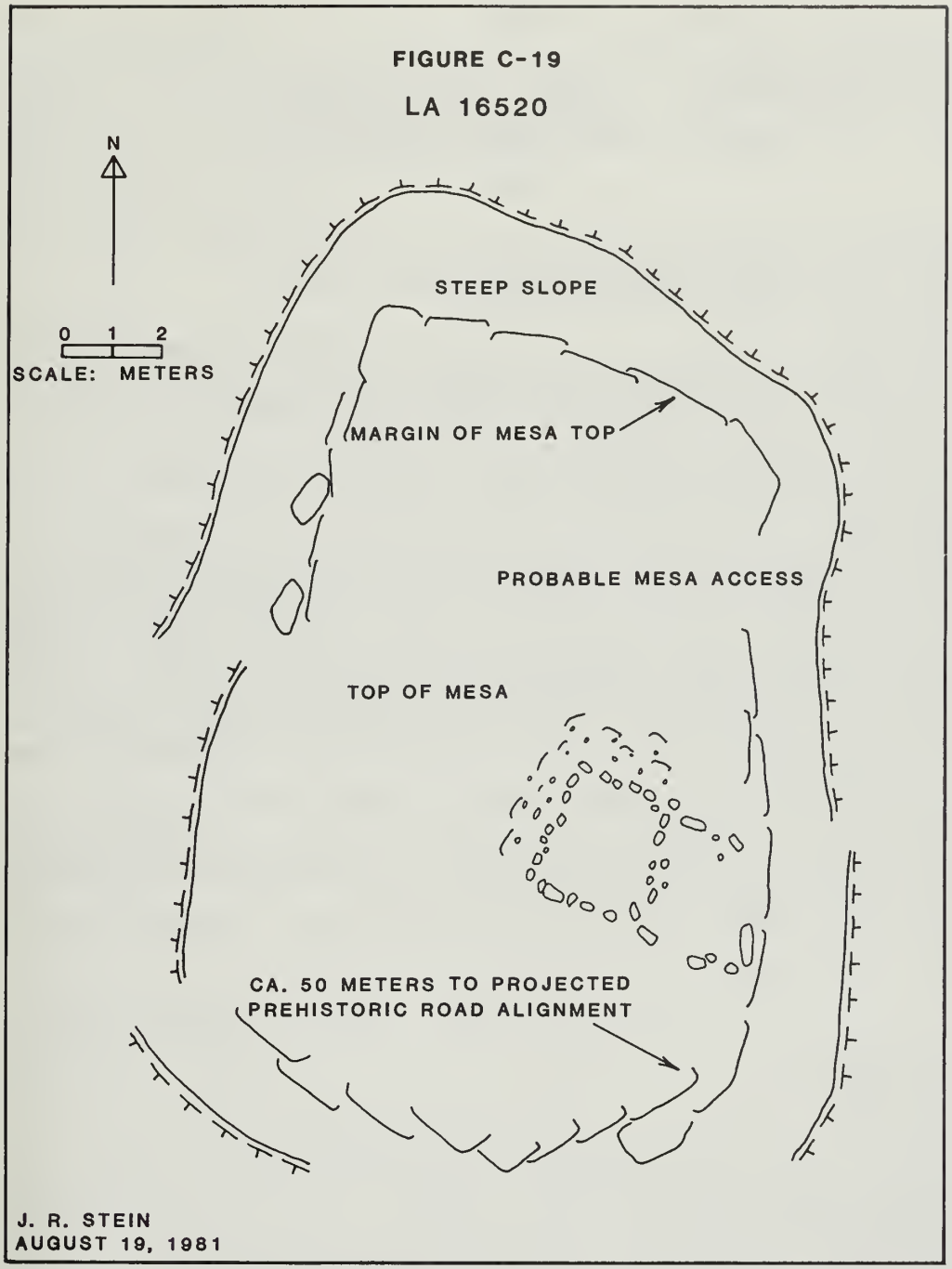
Cibola Grey Ware		
Lino Plain	1	
Corrugated Indented	25	(early--wide coils with deep indentations)
Cibola White Ware		
Unidentified style	8	
Gallup B/W	20	(Chaco B/W may be included)
Escavada B/W	9	
Chuska White Ware		
Unidentified style	1	
Chuska Grey Ware		
Corrugated Indented	11	
Carbon Paint		
Solid Style	3	(either Sosi or McElmo B/W)

*Jar-Bowl ratios not available

Articulation with the Roadway: Association is presumed due to the location of the ruin with respect to a projected bearing of a known prehistoric road.
Site Condition: Reduction is normal and the site is stable.
Comments: Fred York (1982: personal communication) believes that Kimbeto Point may well represent the ruin called Gini'bit'ohi' (Sparrow Hawk's nest) after which Kimbeto Wash is named. Written reference to this ruin can be found in Fransted and Werner (1974:41, 167, 168). and Van Valkenburgh (1941:84). It is very possible that this ruin has religious significance; Van Valkenburgh (1941:84) suggests that it is featured in the legend of The Gambler from the Bead Chant.

★

LA Number: 16520
Other Numbers: CRP Field No. N-1
Recorders: Denise Galley, John Stein, Daisy F. Levine, Peg Van Valen
Cultural Affinity: Eastern Anasazi, Chaco Expression
Temporal Affinity: Marshall: 1075-1175 AD
Road Association: North Road
Topographic Situation: Structure is situated atop a small sandstone-capped butte some 10 m above the valley floor. The location is approximately 700 m northwest of the Pierre's Acropolis (LA 16508-9).
Soil Structure: Sandstone bedrock
Vegetation: Sand sage, rice grass, juniper, snakeweed, miscellaneous grasses
Land Status: Bureau of Land Management
Drainage: Unnamed lateral to Coal Creek
Elevation: 6500'
Site Description: LA 16520 consists of one and possibly two masonry rooms constructed atop a low flat-topped butte (see Figure C-19). Interior dimensions of the most visible of the two rooms are 2.4 x 2.3 m. Relief of the rubble mound approaches .25 m. The room is reduced to a low alignment of unshaped sandstone elements. Wall construction is simple coursed masonry. Quantity is slight; however, walls were likely full height and the structure was likely roofed. Evidence for a second contiguous room is based on a very few scattered elements to the southeast.
Masonry: Walls were constructed of local sandstone, ranging from spalls to blocks .3 x .6 m in size.



Rooms: There are two possibly continguous rooms of simple construction oriented on a northwest to southeast axis. Total structural dimensions are 2.5 x 4 m.
Associated Middens: No formal midden deposition was noted in association with the structure.
Material Culture: Ceramics
Six sherds were found on and below the cap of the butte:

1 Cibola Plain Ware Indeterminate
3 Cibola White Ware Indeterminate
2 McElmo Black-and-White Indeterminate

Material Culture: Ground Stone
One fragment of shaped, ground sandstone was noted, .15 x .05 m in dimensions with one ground surface only. Its function is unknown.

Historic Material: Two "sheep rattles" were noted in the vicinity of the butte. One, located 50 m to the west on a similar butte, was a sanitary crimped seam can (dating to around the 1930's); the other was a hole-in-top turn-of-the-century can.
Articulation with the Roadway: The structure is situated above and to the west of the projected alignment of the North Road where it passes north out of Pierre's Ruin.
Comments: This structure warrants consideration as a road-associated feature due to its elevated situation above and proximity to the projected North Road alignment.

★

LA Number: 34298
Other Numbers: CRP Field No. N-48
Recorder: Denise Galley, Daisy F. Levine, John R. Stein
Temporal Affinity: Marshall: 1080-1125; Weighted Ceramic: 1056-1118
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Structure is situated atop a low ridge standing approximately 6 m above the valley floor, 1 km south of the Pierre's Acropolis. The ridge is located in the valley bottom 300 m south of an unnamed lateral to Coal Creek.
Visible Horizon: Visibility is restricted to the south; Pierre's Ruin is clearly visible to the north.
Soil Structure: Bedrock, sandy aeolian mantle
Vegetation: Sage, saltbush, prickly pear, juniper, snakeweed, rabbitbrush, grasses
Primary Drainage: Unnamed lateral to Coal Creek
Elevation: 6400'
Site Description: The site consists of a ceramic scatter which conforms to the projected alignment of the North Road, the scatter measuring approximately 50 m NS x 20 m EW (long axis parallels the projected alignment). Approximately 50 m west and elevated several meters is the remains of a simple square masonry structure, with interior dimensions of 2 x 2 m. Rubble from the structure is scattered within an area of 4 x 4 m and is reduced to a mound less than .3 m in relief. Quantity of rubble suggests that the small structure was constructed entirely of stone, and roofed. Reduction is advanced and wall alignments are poorly visible. A second concentration of masonry elements is located 86.5 m and 328 degrees from the square room. This concentration is surficial and is scattered in a 2 x 2 m area. Function of this scatter is not known, however, there does not seem to be enough material to represent a structure. No burned elements were noted. This feature is located on the ridge top at the same elevation as the single room.
Masonry: Simple masonry was utilized in construction. Sandstone elements range from .3 x .3 x .3 m to .35 x .2 x .05 m in size.
Associated Middens: No midden deposition was noted in association with the structure, however a very slight scatter of ceramic material was noted in the vicinity. A ceramic scatter was documented within the projected road alignment, concentrated in an eroded cut of that alignment.
Material Culture: Ceramics
From vicinity of structure: 3 Cibola Corrugated Indented Jar sherds, 1 Chuska White Ware Jar sherd
Sample from Road Alignment:

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Cibola Corrugated	15			15
Cibola Plain			5	5
Cibola White Ware				
Undiagnostic	23	5		28
Escavada B/W	2	2		4
Gallup B/W	5	4		9
Chaco B/W	2			2
Mesa Verde White Ware				
Undiagnostic			1	1
McElmo B/W		2		2
Chuska Grey Ware				
Chuska Corrugated	1			1
White Mountain Red Ware				
Undiagnostic	1			1
Puerco B/R		1		1
Wingate B/R	1			1
Socorro B/W	1			

Articulation with the Roadway: Structure is elevated above and located approximately 50 m west of the projected center line of the North Road.
Comments: LA 34298 is considered to be associated with the North Road by virtue of its close proximity to and elevated situation above the alignment. Also taken into consideration is the similarity to LA 16520 which flanks the North Road as it leaves (enters) Pierre's Ruin from the North.

★

Site Name: Burned Jacal
LA Number: 34304
Recorder: Denise Galley, Ben Robertson, Daisy F. Levine, John R. Stein, Peg Van Valen
References: Thomas Windes (1982: personal communication)
Temporal Affinity: Marshall: 1000-1125 AD; Weighted Ceramic: 1052-1141
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: The site is situated on the southern margin of the elevated landform referred to as the Gallegos Divide.
Visible Horizon: Visibility from the site location is excellent. Angel Peak is visible to the north and the ridge above Pierre's Ruin is visible to the south. It is conceivable that if the Pierre's Ruin structures were standing to full height that they would be visible from this location.
Soil Structure: Clay, sandy loam
Vegetation: Sage, grasses, juniper, pinyon
Elevation: 6872'
Site Description: The site consists of two concentrations of burned adobe representing the remains of jacal structures destroyed by fire. Concentration No. 1 is approximately 5 x 5 m in extent and is of negligible relief. Concentration No. 2 is much more substantial and appears to have some depth. Large chunks of burned adobe have eroded downslope from the structure.
Articulation with the Roadway: This site is located adjacent and to the west of a swale identified as the North Road. At this point the road is on an elevated position at the lip of a ridge which drops off radically to the south through a series of badland exposures and sage flats. Visibility from the site area is excellent. Angel Peak is clearly visible, and to the south the ridgetop above Pierre's Ruin dominates the horizon. Pierre's may have been visible from this location while still standing. The swale identified as the alignment of the North Road is on a bearing of virtually true north, is 17 m in width, .40 m in depth, and is visible for a distance of 50 m.
Middens: No formal midden deposition exists in the vicinity of the site. A surficial scatter of ceramic material is in evidence in the area of the swale presumed to be the North Road; it is intermixed with large chunks of fired adobe on the slopes to the south and east of the structures. This tally of the material culture evident in the site vicinity represents approximately 90% of the material on the surface.
Material Culture: Ceramics

	Jar	Bowl	Indeterminate
Cibola Grey Ware			
Corrugated Indented	7		
Cibola White Ware			
Undiagnostic	4		5
Red Mesa B/W	3		
Chaco B/W	1		
Mesa Verde White Ware			
Undiagnostic	1	1	
McElmo B/W		3	
Chuska Grey Ware			
Corrugated Indented	2		
White Mountain Red Ware			
Wingate B/R		2	

Material Culture: Lithics
No lithics were observed in the site area

Articulation with the Roadway: Structural remains are located on the western margin of the swale identified as a segment of the North Road. The direct articulation of the structure with the road surface, and its location on the extreme margin of a major landform conform with the locational criteria described for the Herradura. Similarly, the topographic expression of the road surface is enhanced in the area of the structures and ceramic density is higher than elsewhere on the road alignment, although no formal midden deposition is present. This is also consistent with the criteria described for the Herradura. The use of jacal is noteworthy since few sites are known to have utilized this construction mode late in the Chaco Sequence. The low masonry walls of the Herraduras in the southern quadrant of the San Juan Basin indicate a possibility that jacal was used as a superstructure in these sites as well.

★

Site Name: Upper Twin Angels Overlook
LA Number: 34305
Other Numbers: CRP Field No. N-6
Recorder: Daisy F. Levine, Peg Van Valen, John R. Stein, Denise Galley, Ben Robertson
Temporal Affinity: Marshall: 1080-1125 AD

Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Site is situated atop a steep-walled badland pinnacle standing several hundred feet above the floor of Kutz Canyon. The pinnacle stands near the canyon rim and flanks the North Road to the east where it drops into the canyon below. The spectacular nature of the setting is illustrated by the presence of the Kutz Canyon Overlook at this location. The Overlook restrooms were situated dead center in the imaged alignment of the North Road, a situation which eased backsighting of the road alignment. Access to the top of the pinnacle today is extremely precarious.
Visible Horizon: Angel Peak is visible to the east, the La Plata mountains to the north. The site area commands a spectacular view of the Kutz Canyon Drainage. Flare-up experiments conducted by the Chaco Center in the 1970s demonstrated that Halfway House is below the horizon (Robert Powers 1982: personal communication).
Soil Structure: Badland (clay)
Vegetation: None
Primary Drainage: Kutz Canyon Wash
Elevation: 6300'
Site Description: Modification of the cap of the pinnacle consists of a masonry wall approximately .5 m in height which conforms to the natural contour of the pinnacle margin. As there are no alignments evident to indicate internal division of the structure, the configuration of the outside wall suggests that an artifical platform 5 x 6 m in dimension may be present. Structural remains, however, are in an advanced state of reduction evidenced by a quantity of rubble which has accumulated at the base of the slope. This situation precludes accurate assessment of the character of the structure.
Masonry: Visible portions of wall indicate that construction atop the pinnacle was of simple to compound masonry. Masonry elements are dense dark brown sandstones which range from spalls to blocks .3 x .3 x .2 m in size.
Middens: There is no midden formation associated with the structural remains. A very slight scatter of ceramic and lithic material was documented in the site vicinity.
Material Culture: Ceramics
3 Corrugated Indented (same vessel)
1 Cibola Whiteware (jar)
Material Culture: Lithics
Quartzite: 1 flake 1 hammerstone

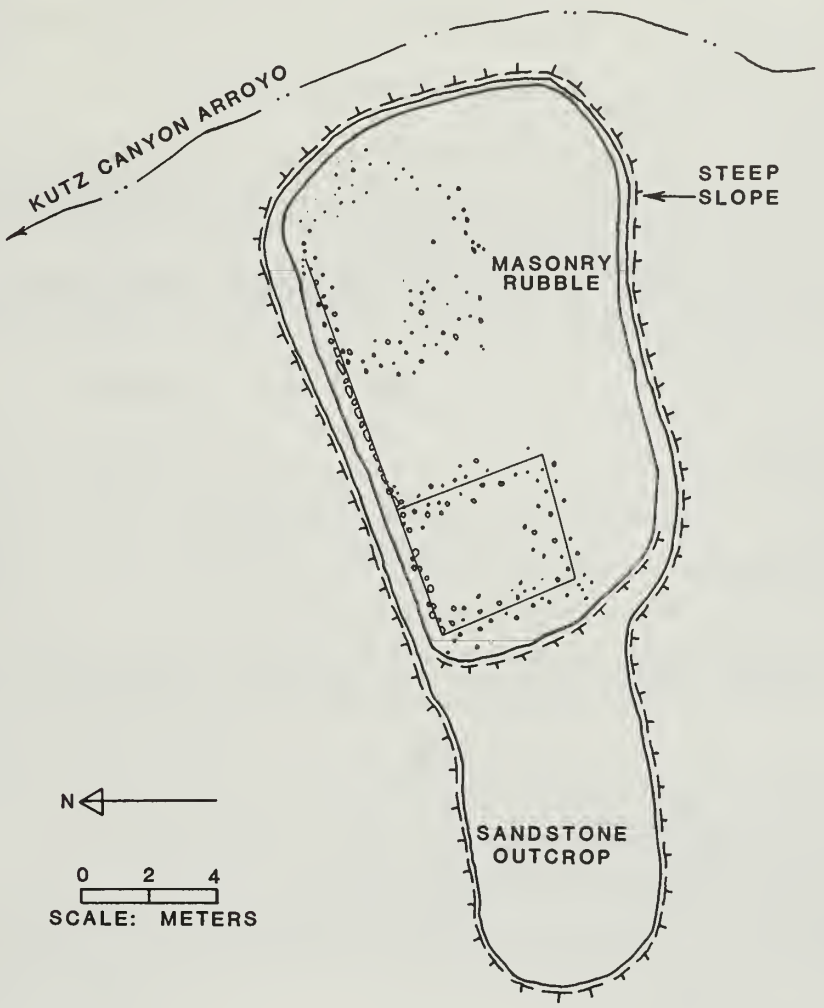
Articulation with Roadway: The structure stands isolated 273 degrees and 150 m from the location where the North Road drops into Kutz Canyon Wash, a dramatic descent. There is no evidence on the ground to suggest how this descent was accomplished.
Site Condition: Several small potholes have been excavated into the site area. Masonry rubble from these digs has been stacked or incorporated into two small cairns.

★

Site Name: Lower Kutz Canyon Overlook
LA Number: 34306
Other Numbers: CRP Field No. N-7
Recorder: Daisy F. Levine, Peg Van Valen, Denise Galley, John R. Stein
Temporal Affinity: Marshall: 1000-1050 AD; Weighted Ceramic: 1058-1107 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: The site is situated atop an isolated butte standing approximately 25 m above the floor of Kutz Canyon.
Visible Horizon: The Upper Overlook (LA 34305) is visible from here and is presumably the location where the North Road enters Kutz Canyon. Otherwise visibility is restricted.
Soil Structure: Badland and sandstone substrate with shallow sand cap
Vegetation: Shadscale, sage and grasses
Primary Drainage: Kutz Canyon Wash
Elevation: 6074'
Site Description: This site consists of the remains of two non-contiguous masonry rooms connected by a low wall (see Figure C-20). The relief of the rubble mound varies from .05 to .75 m. Because of the advanced state of reduction actual shape of the rooms is uncertain; the easternmost of the two rooms may be circular. Maximum dimensions of the structural remains are 12 x 6 m with an orientation to the southeast suggested by the placement of the rear wall.
Masonry: The state of reduction suggests that the structures were constructed of simple coursed masonry utilizing sandstone slabs and blocks up to .2 x .35 x .05 m in size.
Middens: No formal midden deposition was noted in the vicinity of the structural remains. A very slight scatter of ceramic material was recorded on the slopes of the low butte.
Material Culture: Ceramics

FIGURE C-20

LA 34306



JUNE 10, 1981
J. STEIN, D. GALLEY, D. LEVINE, B. ROBINSON

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Corrugated Indented	4			4
Cibola White Ware				
Undiagnostic	4	1		5
Gallup B/W	2			2

Articulation with the Roadway: The North Road is no longer visible once it enters Kutz Canyon. The road is presumed to angle down the canyon toward the Kutz Canyon Ruin (LA 5642) and ultimately arrive at the Salmon Ruin which is situated on the north bank of the San Juan River opposite the confluence with Kutz Canyon. The broken terrain in the canyon bottom has so far precluded location of the road alignment. Any associated material culture is likely buried in the wash bottom. The location of the ruin here referred to as the Lower Kutz Canyon Cap Overlook site is certainly suggestive that the road does indeed drop into the canyon at this location; however, the actual position of the road alignment with respect to the ruin is not currently known.

★

LA Number: 34307
Other Numbers: CRP Field No. N-8
Recorder: Daisy F. Levine, Denise Galley, Peg Van Valen, John R. Stein
Temporal Affinity: Marshall: 1000-1050 AD; Weighted Ceramic: 1000-1111 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: The structural remains are situated atop a low dune, elevated somewhat above the surrounding sage flats. Site location is approximately 100 m south of the rim of Kutz Canyon.
Visible Horizon: Angel Peak and Huerfano Mountain are visible on the horizon. As mentioned in the site discussion for LA 34305, this ruin may provide a visual link with the Kutz Canyon rim and Halfway House.
Soil Structure: Sand
Vegetation: Saltbush, ephedra, sage, wolfberry, miscellaneous grasses
Primary Drainage: Kutz Canyon Wash
Elevation: 6570'
Site Description: The site consists of the reduced remains of a simple masonry structure. Masonry elements are scattered in a 10.0 x 15.0 m area with no visible alignments. Actual size and shape of the structure are unknown. Masonry elements are of unshaped sandstone ranging from .10 x .10 m to .30 x .50 m in size. The site area has been reutilized during recent times which may account for the advanced state of reduction.
Middens: No formal deposition was documented in the vicinity of the masonry concentration. A very slight scatter of ceramic material was located on the dune to the south and east of the structure.
Material Culture: Ceramics

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Plain			1	1
Corrugated Indented	1			1
Cibola White Ware				
Undiagnostic	2	1		3
Red Mesa B/W		1		1
Escavada B/W		2		2
Mesa Verde White Ware				
McElmo B/W	1			1
TOTAL:				9

Articulation with the Roadway: The remains of this structure are slightly elevated above and immediately west of the alignment of the North Road. Because the site area has been reused during recent times any physical evidence of the prehistoric roadway has been obscured.

★

LA Number: 34213
Other Numbers: CRP Field No. S-6
Recorder: John R. Stein, Daisy F. Levine
Temporal Affinity: Marshall: 850-1000 AD; Weighted Ceramic: 792-949 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: South Road (?)
Topographic Situation: The structure is located on a high ridge flanking a lateral to the Kin Klizhin Wash.
Visible Horizon: La Mesita de la Junta
Soil Structure: Sandy loam
Vegetation: Grasses, saltbush
Primary Drainage: Kin Klizhin Wash
Elevation: 6380'
Site Description: The site consists of two reduced masonry rooms and a possible small subterranean kiva. The rooms are noncontiguous but are connected on the northern exposure by a wall which results in a small enclosed courtyard flanked by the two rooms. Wall alignments are poorly visible; however, the rooms appear to have been rectangular and 4 x 4 m in interior dimensions. Mound relief approaches 1 m.
Masonry: The rooms appear to have been constructed to full height of simple to compound masonry utilizing elements of dense dark brown sandstone. Elements are tabular slabs averaging .3 x .3 x .05 m in size. Scabbling is evident on several slabs.
Kiva: A very slight depression is located immediately south of the structure which suggests the presence of a small subterranean kiva. A sizable area south of the structure is slightly depressed and unnaturally level suggesting the possibility of a plaza surface.
Middens: A dense midden is located 18 m southeast of the structure and measures 35 x 20 m. Depth of the deposition is estimated at 1.5 m. Midden surface is characterized by a high density of

cultural material in association with burned slabs, spalls and the remains of slab hearths.
Material Culture: Ceramics
Sample area 2 x 2 m:

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Plain	33			33
Wide Banded	4			4
Narrow Banded	7			7
Corrugated Indented				
Medicine Style	7			7
Tusayan Style	11			11
Cibola White Ware				
Course Temper			3	3
Fine Temper			9	9
Red Mesa B/W	8	5		13
Gallup B/W	1	1		2
La Plata B/W	2	3		5
TOTAL:				94

Material Culture: Lithics

Miscellaneous Chalcedony	4
Petrified Wood	4

Articulation with the Roadway: This structure is located slightly above and 50 m west of the South Road. The early date, presence of a small subterranean kiva and associated midden deposition suggest that this is a small residential structure, and that the proximity to the South Road is fortuitous.

LA Number: 34214
Other Numbers: CRP Field No. S-7
Recorder: John R. Stein, Daily F. Levine
References: Powers, Lekson and Gillespie 1977
Temporal Affinity: Marshall: 950-1000 AD; Weighted Ceramic: 899-1092 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: The site is located in vicinity of the South Road but association with it is questionable.
Topographic Situation: The site is located on the crest of a high ridge flanking a lateral to the Kin Klizhin Wash.
Visible Horizon: La Mesita de la Junta
Soil Structure: Sandy loam
Vegetation: Grasses, saltbush
Primary Drainage: Kin Klizhin Wash
Elevation: 6380'
Site Description: The site consists of a low rubble mound representing two possible masonry rooms. Overall size of the structure is 7 x 8 m. Partial alignments indicate that one room measures 4 x 4 m in interior dimensions. Relief of the rubble mound is approximately 1.5 m and is partially obscured by windblown sand. Curiously the structure seems to be oriented to the northeast.
Masonry: The structure appears to have been constructed of simple to compound masonry incorporating scabbled elongated slabs of dense dark sandstone up to .4 x .3 x .05 m in size.
Middens: A formal midden is located to the east-southeast of the structure. This midden measures roughly 28 x 18 m and is estimated at .75 m in depth. Cultural material is moderately dense with burned spalls present.
Material Culture: Ceramics
2 x 2 m sample area in midden

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Corrugated Indented	2			2
Cibola White Ware			3	3
Red Mesa B/W	3	3		6
Gallup B/W	1	1		2
Chuska Grey Ware				
Corrugated Indented	1			1
Chuska White Ware				
(Pena/Theodore B/W)			1	1
TOTAL:				15

Material Culture: Lithics

Petrified Wood	4

Chinle Chert	1
Washington Pass Chert	1
Black Chert	1
Chalcedony	3

Articulation with the Roadway: The structure is located 50 m west of the roadway and is slightly elevated above it. The nature of the association of this structure, if any, with the South Road is not known.

★

LA Number: 35416
Temporal Affinity: Marshall: 1000-1125 AD; Weighted Ceramic: 789-1048 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: The site is situated atop a small isolated sandstone-capped badland outcrop extending approximately 8 m above the floor of the gentle slope to Casa del Rio which is 800 m to the east northeast.
Soil Structure: Sandstone bedrock
Drainage: Chaco Wash
Elevation: 6040'
Site Description: The site consists of a single rectangular masonry room 2.2 x 2.4 m in interior dimensions (see Figure C-21). Walls are reduced to alignments .15 m in relief. The presence of scattered masonry elements suggests that the structure was not substantial and possibly was not roofed. Construction is of simple masonry incorporating irregular, angular unshaped elements of a variety of sandstones. There is evidence that the structure may have been burned. Large bedrock elements are incorporated into the north wall of the structure.
Associated Middens: No formal midden is associated with the structure, although ceramics are scattered on the surface in the vicinity of the ruin.
Sample No. 1
Material Culture: Ceramics
Tally from immediate site vicinity

	Jar	Bowl	Indet.	Total
Cibola White Ware				
Red Mesa B/W	2	2		4
Gallup B/W		1		1
Cibola Undifferentiated	4	2	3	9
Chuska Grey Ware				
Chuska Plain	1		3	4
Chuska Corrugated	1			1
Chuska Banded (Wide)	2			2
Mesa Verde White Ware				
Carbon B/W (Mesa Verde-McElmo)		1		1
TOTAL:				22

Material Culture: Lithics No lithics or ground stone materials were noted.
Tally from the projected road alignment north, east and west of site area

Sample No. 2
Material Culture: Ceramics
Tally from immediate site vicinity

Cibola Grey Ware				
Cibola Banded	4			4
Cibola Corrugated	1			1
Cibola Plainware	14	1		15
Cibola White Ware				
Undiagnostic Cibola White Ware	13	13	13	39
Red Mesa B/W	5	5	1	11
Gallup B/W		2		
Carbon Paint White Ware				
Chaco B/W		2		2
McElmo B/W	2		1	3
Chuska Grey Ware				
Chuska Plain Ware	16			16
Chuska Narrow Banded	2			2
Chuska Corrugated	13			13
Chuska White Ware				
Undiagnostic Chuska White Ware	1	2	3	6
Chuska Red Mesa Style	1			1

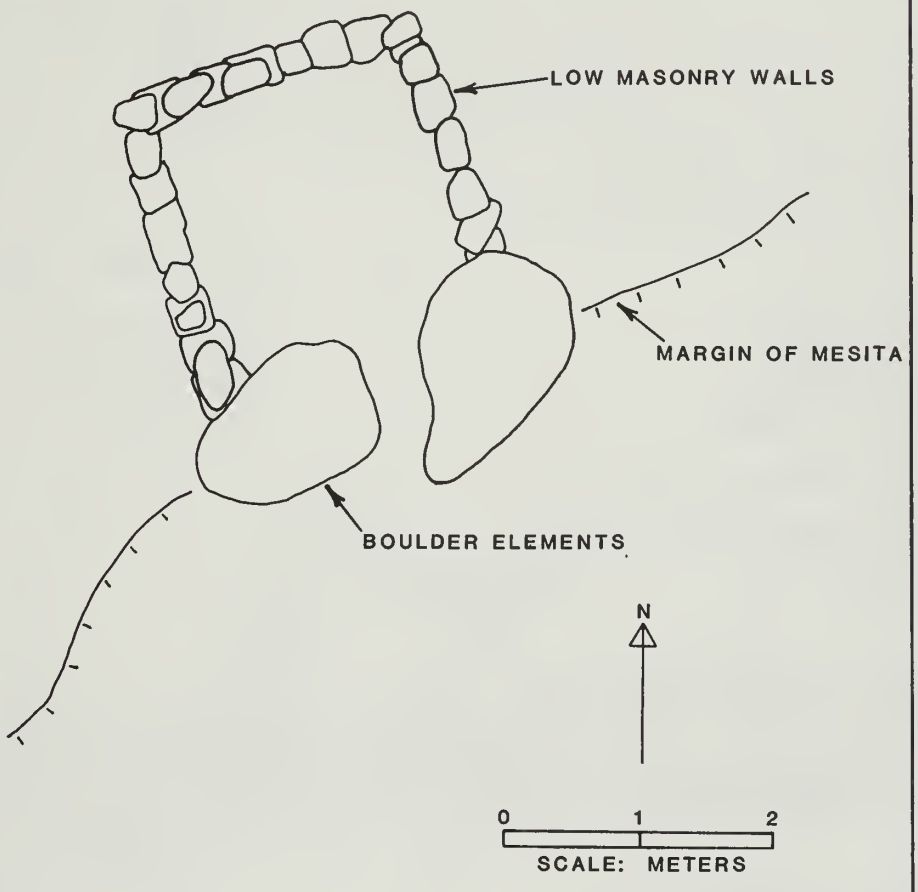
Material Culture: Lithics

Pedernal-like Chert	1
Washington Pass Chert	1 (projectile point)
Petrified Wood	1

FIGURE C-21

MASONRY STRUCTURE

LA 35416



J.R. STEIN
JULY 8, 1981

Articulation with the Roadway: This structure is situated immediately above and south of the imaged Casa del Rio to Lake Valley Road, approximately 800 m west of Casa del Rio. Association is inferred from the elevated situation and close proximity to the road alignment.
Comments: Work on this segment of the road needs to be more carefully done in order to demonstrate the distribution of ceramics with respect to the road alignment, to quantify the density of ceramic material, and to determine whether the feature described herein can be considered road-associated.

★

Site Name: Gallegos Crossing
LA Number: 34303
Other Numbers: CRP Field No. N-9
Recorder: Daisy F. Levine, Peg Van Valen and John R. Stein
Temporal Affinity: Marshall: 1000-1100 AD; Weighted Ceramic: 1103-1127 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: North Road
Topographic Situation: Site is situated on a low knoll 12.5 m above and 200 m northeast of the Gallegos Wash and 3.3 km north of Halfway House.
Visible Horizon: Huerfano Mountain is visible to the east.
Soil Structure: Sandy loam
Vegetation: Snakeweed, grasses, sage, chamisa
Primary Drainage: Gallegos Wash
Elevation: 6440'
Site Description: The site consists of exposed masonry in a 25 x 20 m area atop a sand ridge which commands a view of the Gallegos drainage. Exposed sandstone elements range from slabs and spalls .1 x .1 m to .3 x .3 m in size. Some of the surface rubble has been restacked into a small cairn in historic times. The quantity of rubble present suggests a simple masonry structure of unknown shape and dimensions. Wall alignments are not visible.
Masonry: The character and quantity of exposed masonry suggest that the structure was of simple masonry construction. Whether the walls were full height is not known.
Middens: No formal midden deposition was noted in the site vicinity although a slight scatter of cultural material was noted downslope to the south and west.
Material Culture: Ceramics
Sample consists of all material in a 20 x 30 m area west of the structural remains within the projected alignment of the North Road.

	Jar	Bowl	Indet.	Total
Cibola Grey Ware				
Plain	4			4
Corrugated Indented	17			17
Cibola White Ware				
Undifferentiated		1		1
Red Mesa B/W		1		1
Mesa Verde White Ware				
McElmo B/W	1			1
Chuska Grey Ware				
Corrugated Indented	1			1
TOTAL:				25

Material Culture: Lithics

Petrified Wood	1	
Quartzite	1	(hammerstone)
Chalcedony	1	
Possible Fire-Cracked Rock		

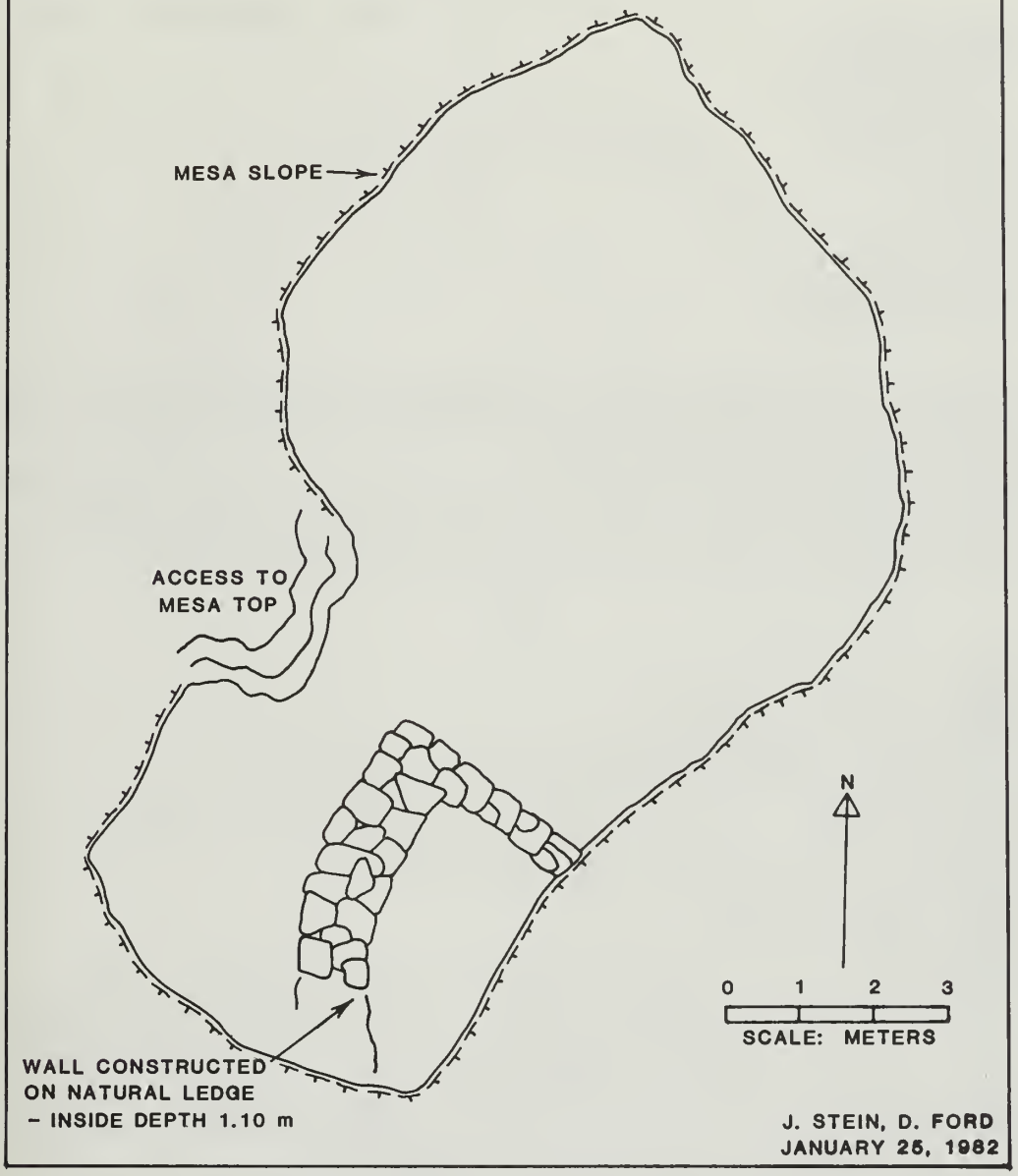
Articulation with the Roadway: The structure is located above and approximately 15 m east of the projected alignment of the North Road.
Comments: Scarcity of cultural material, topographic situation and relationship to the projected road alignment strongly suggest that this small structure may be road-related. The presence of a hammerstone and fire-cracked rock debris in the road alignment may be the result of either an earlier occupation of the site vicinity, lateral movement of materials following abandonment of the structure, or perhaps mis-identification of the road alignment. The area where the prehistoric alignment is projected is very eroded.

★

Site Name: La Mesita de La Junta
LA Number: 34230
Other Numbers: Chaco Center Survey Number: 29 MC 1867; CRP Field No. S-23
Recorder: John R. Stein, Dabney Ford, Daisy F. Levine
Temporal Affinity: Marshall: 950-1050 AD; Weighted Ceramics: 802-1026 AD
Cultural Affinity: Eastern Anasazi, Chaco Expression
Road Association: South Road
Topographic Situation: The structure is situated atop an isolated sandstone pinnacle which stands over 12 m above the valley floor on the southern margin of the Kin Klizhin Valley. Although not a large natural feature this pinnacle is certainly a prominent one; it is visible for over 5 km from the north and looms up quite suddenly, centered in the road alignment, when one approaches from the south.
Visible Horizon: Fajada Butte, South Gap, Casa Patricio, Upper Kin Klizhin and Tse Ka'a
Soil Structure: Pinnacle is composed of sandstone bedrock; surface beneath the pinnacle is clay hardpan with shallow sand overlay.

FIGURE C-22

LA MESITA DE LA JUNTA LA 34230



Vegetation: Wolfberry, sand sage, skunk bush, squawberry
Primary Drainage: Kin Klizhin Wash
Elevation: 6530'
Site Description: The site consists of an "L"-shaped masonry feature which walls-off the southeastern corner of the sandstone pinnacle described above (see Figure C-22). The resulting enclosure measures 4.5 x 3.0 m in interior dimensions, with the opening exposed to the southeast. Masonry construction is compound in nature, utilizing large slabs of dense dark brown sandstone available locally. Walls are massive, measuring .8 m for the west wall and .4 m for the north wall. Maximum standing wall height approaches .6 m. Lack of rubble in the site vicinity suggests that the structure retains much of its original proportions. The structure was apparently not roofed.

Associated Middens: No formal middens were associated with the structure. Only a tiny fragment of turquoise was found on the summit of the pinnacle. A moderate scatter of ceramics was strewn on the slopes beneath the structure in the vicinity of the projected alignment of the South Road.
Material Culture: Ceramics
Sample taken from vicinity of South Road alignment

	Jar	Bowl	Indeterminate	Total
Cibola Grey Ware				
Plain (coarse temper)	7			7
Plain (fine temper)	3			3
Narrow Banded	1			1
Corrugated Indented	4			4
Cibola White Ware				
Undifferentiated			13	13
Red Mesa B/W	4	3		7
Gallup B/W	2	1		3
Chuska White Ware				
Red Mesa Style		1		1
Mesa Verde Style		1		1
White Mountain Red Ware				
Undifferentiated		1		1
TOTAL:				41

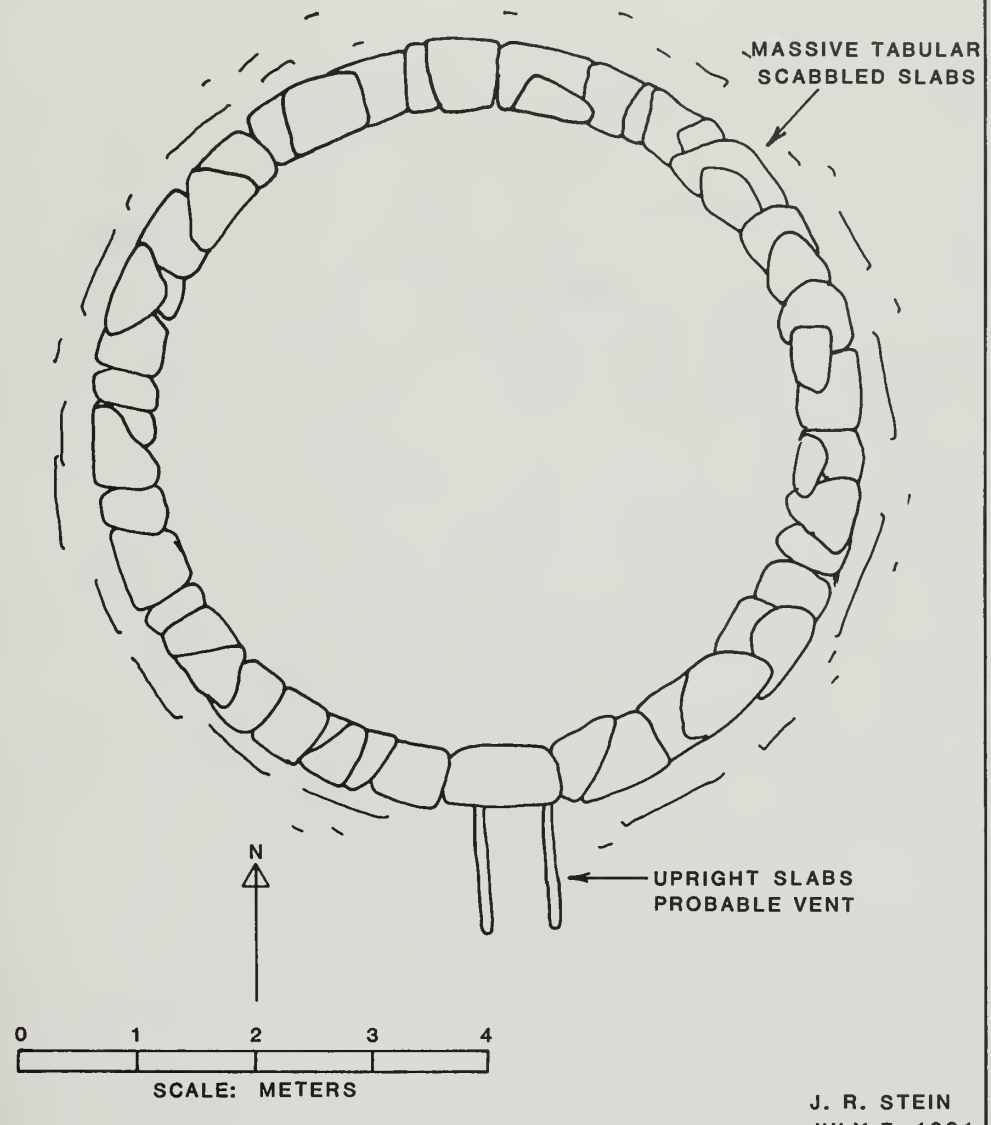
Articulation with the Roadway: La Mesita de La Junta appears to be a structure associated with the South Road as the alignment jumps up the southern margin of the Upper Kin Klizhin Wash and changes bearing toward Satan Pass and Kin Ya'a. The projected alignment of the South Road would pass directly below La Mesita to the east.
Comments: La Mesita exhibits the characteristics of architectural features often called "shrines" (Hayes and Windes 1975; Marshall et al. 1979:63-65). Specific criteria for these types of structures has been developed by Windes (1977a, 1982: personal communication). Although visibility is obviously a consideration in the location of La Mesita and "signaling" from this location is a possibility, there is no evidence that fires were ever built here.

★

Site Name: Tse Nizhoni (Pretty Rock)
LA Number: 37676
Recorder: Richard Loose, John Stein
References: Fransted and Werner (1974)
Temporal Affinity: Presumed to date to first quarter of the twelfth century
Cultural Affinity: Eastern Anasazi, Chaco Expression
Topographic Situation: This site is situated atop the prominent sandstone-capped mesa known as Tse Nizhoni.
Visible Horizon: The site commands a view to the north and west.
Soil Structure: Primarily bedrock with a shallow sand cap
Vegetation: Shadscale, snakeweed
Primary Drainage: Tsaya Wash
Elevation: 6320'
Site Description: The site consists of a coursed masonry stone circle 5.4 m in interior diameter (see Figure C-23). Standing wall height is .4 m and the lack of rubble suggests that this is close to the original height of the wall. An apparent "vent" opening is located at the base of the wall 175 degrees from the center of the structure. This feature constitutes the only opening in the structure and is formalized by two massive slabs 1 m in length set parallel .5 m apart. The opening is covered by a large slab.
Masonry: The structure is constructed of simple coursed masonry. Wall elements are dark brown indurated sandstone slabs up to .5 x .4 x .05 m in size. Shaping by scabbling is apparent on some slabs. Wall thickness is .55 m and is a single element wide.
Middens: No material culture was noted in association with the structure. Richard Loose (1982: personal communication) remembers that when the site was first discovered, an unidentified Cibola Series White ware sherd was found in the vicinity. This sherd could not be relocated.
Comments: This masonry circle is certainly of Anasazi origin, although with the lack of material culture exact temporal placement is impossible.

FIGURE C-23

TZE NIZHONI (PRETTY ROCK)
LA 37676



Site Name: Medicine Hogan
LA Number: 41088
Other Numbers: Chaco Center Survey Number: 29 SJ 1088
Recorder: National Park Service
Temporal Affinity: First quarter of twelfth century
Cultural Affinity: Eastern Anasazi, Chaco Expression

Topographic Situation: The site is constructed on the extreme southwestern tip of the Chaco West Mesa, where the mesa falls away in a series of sheer cliffs. Since construction of the site a portion of the cliff edge supporting the structure has pulled away, literally splitting the ruin down the middle. A massive block of sandstone has slumped, and one half of the structure is now higher than the other.
Visible Horizon: This structure affords a commanding view of the terrain west and south of West Mesa. This includes the Chaco Valley and the confluence of the Chaco and Kin Klizhin Washes. Visible features include Kin Klizhin, Padilla Well Pueblo, Casa Del Rio Pueblo, Tse Ka'a, White Rock and Hosta Butte.
Soil Structure: Bedrock
Land Status: National Park Service
Primary Drainage: Chaco Wash
Elevation: 6520'
Site Description: The site consists of a circular simple masonry structure, 7 m in diameter. Walls are standing to a height of 1 m and the absence of rubble suggests that this approximates the original height of the walls. Although the structure is now damaged by a 1 m wide rift in the cliff face there is evidence for an opening to the east, perhaps a vent similar to the one at LA 37676 on Pretty Rock. Perhaps the most interesting aspect of this site is the association of 13 massive cairns ranging from 1.8 m high x 1 m in diameter (the largest) to .5 m high x .4 m in diameter (the smallest). Construction of the cairns is rubble core and most are still standing. They are generally evenly spaced from the circular structure, 11 to the south and 2 possible to the north. The cairns appear to be larger as one approaches the shrine. Looking up at West Mesa from the Padilla Well area, the cairns give the mesa edge a crenelated appearance.
Masonry: Elements consist of large slabs of dense dark brown sandstone which are available locally. A relatively massive wall is attained by incorporation of the elements into the wall in a compound manner.
Associated Middens: Formal midden deposition is lacking in the site area.

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GENERAL LOCATION MAP

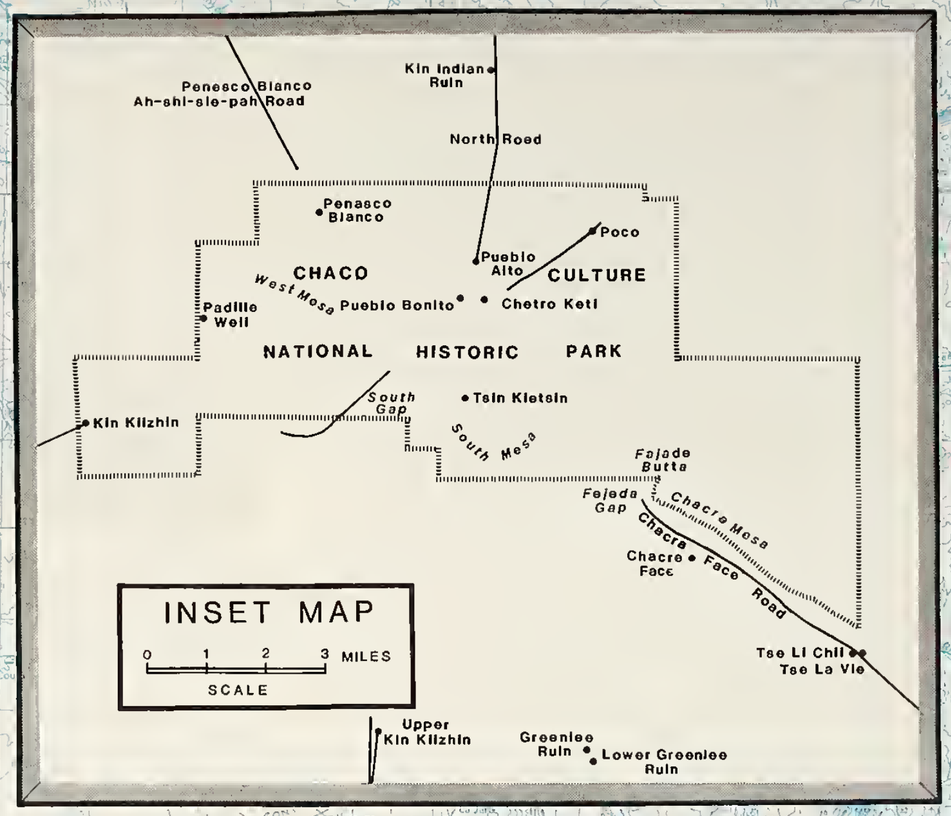
FIGURE 4-1

Map showing general location of selected sites and major photo-interpreted road systems and segments in the San Juan Basin. Additional detail for the Chaco Canyon area may be found in Figures 4-13, A-2, and A-3.

0 10 20 MILES

SCALE

N



NORTH ROAD SURVEY CORRIDOR

FIGURE 8-4

PIERRE'S RUIN COMPLEX
EL FARO
ACROPOLIS
PIERRE'S CAUSEWAY
LEO'S HOGAN
KIN INOIAN RUINS
Trench 1
Trench 2
Trench 3
Trench 4
Trench 5
Trench 8
Trench 9
Trench 10
Trench 13
Wash
Yazzi Well
Well
Indian Ruins
Landing Strips
Chaco Canyon Trading Post
TO PUEBLO ALTO
BM 6214
BM 6281
BM 6140
R 10 W
R 9 W
T 25 N
T 24 N

SCALE: 0 — 1/2 — 1 MILE

N

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PENASCO BLANCO TO AH-SHI-SLE-PAH ROAD SURVEY CORRIDOR

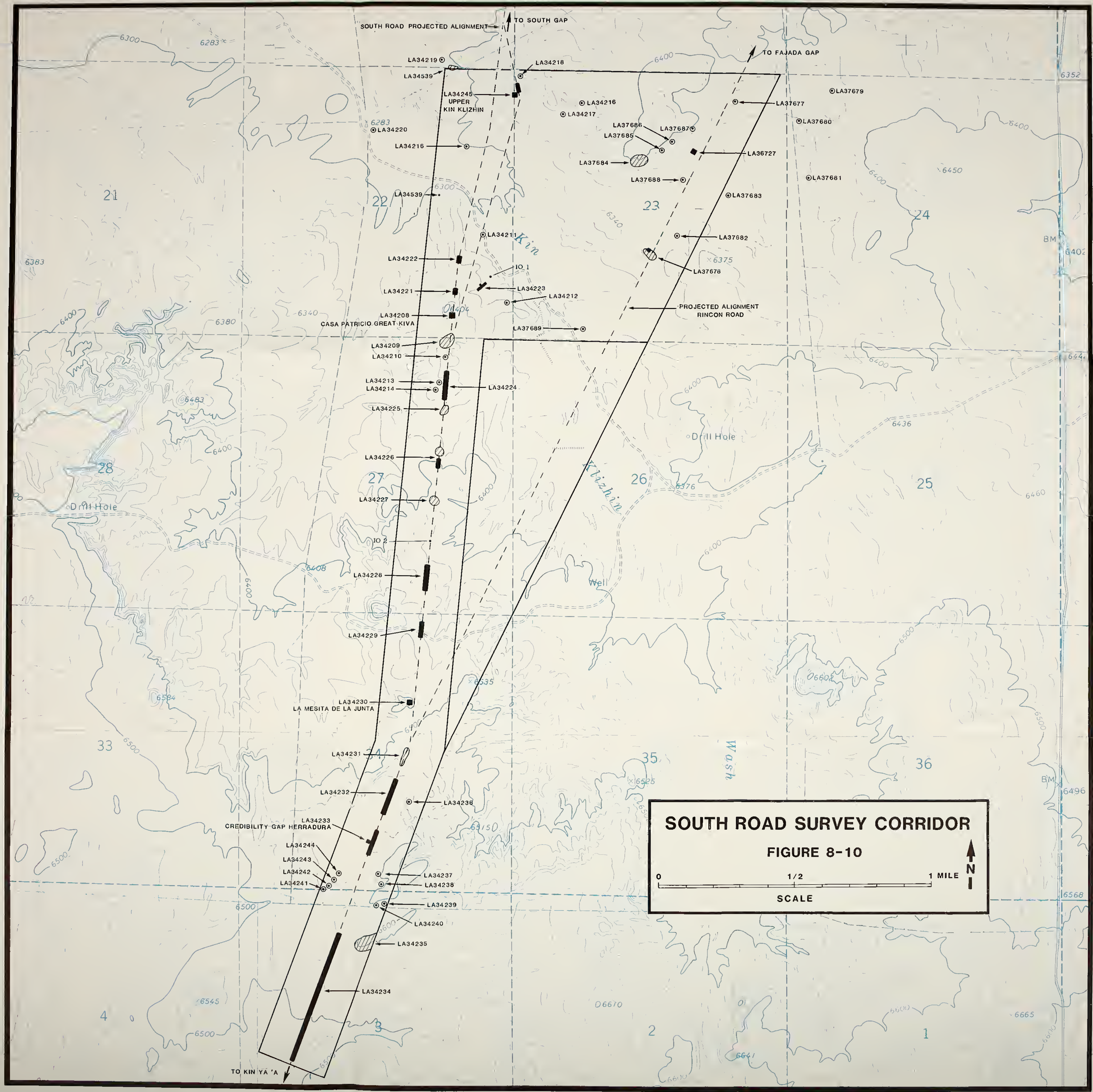
FIGURE 8-7

0 1/2 1 MILE

SCALE

N

LA34324
IO 32
LA34541
IO 15
IO 29
LA34328
LA34323
LA34327
IO 30
LA34322
TRANSECT 4
TRANSECT 3
IO 16
LA34325
IO 17
LA34321
IO 18
LA34326
IO 19
IO 31
TRANSECT 5
TRANSECT 2
IO 20
IO 28
IO 21
IO 23
LA34320
LOS AGUAGES
IO 22
LA34331
TRANSECT 6
TRANSECT 1
TRASH TRANSECT
IO 26
LA34330
LA34319
OLD WAGON ROAD
IO 25
IO 12
LA34318
TRENCH 12
TRENCH 11
IO 10
IO 11
IO 13
LA34317
TRASH TRANSECT
LA34329
CONTEMPORARY
TWO-TRACK MAIN ROAD
IO 6
IO 7
LA34316
IO 9
IO 1
LA34315
LA34314
LA34313
IO 5
LA34312
IO 4
LA34311
LA34308
IO 2
IO 3
LA34310
LA34309
STAIRWAY COMPLEX
TO PENASCO BLANCO


SOUTH ROAD PROJECTED ALIGNMENT
TO SOUTH GAP
TO FAJADA GAP
LA34219
LA34218
LA34539
LA34245
UPPER
KIN KLIZHIN
LA34216
LA34217
LA34220
LA37679
LA37677
LA37680
LA37686
LA37687
LA37685
LA36727
LA37684
LA37688
LA37681
LA37683
LA34539
LA34211
Kin
LA37682
LA34222
IO 1
LA37678
LA34221
LA34223
LA34212
PROJECTED ALIGNMENT
RINCON ROAD
LA34208
CASA PATRICIO GREAT KIVA
LA37689
LA34209
LA34210
LA34213
LA34214
LA34224
LA34225
Drill Hole
LA34226
LA34227
Klizhin
Drill Hole
IO 2
LA34228
Well
LA34229
LA34230
LA MESITA DE LA JUNTA
LA34231
LA34232
LA34236
LA34233
CREDIBILITY GAP HERRADURA
LA34244
LA34243
LA34242
LA34241
LA34237
LA34238
LA34239
LA34240
LA34235
LA34234
Wash
TO KIN YA 'A
21
22
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SOUTH ROAD SURVEY CORRIDOR
FIGURE 8-10
0
1/2
1 MILE
SCALE
N

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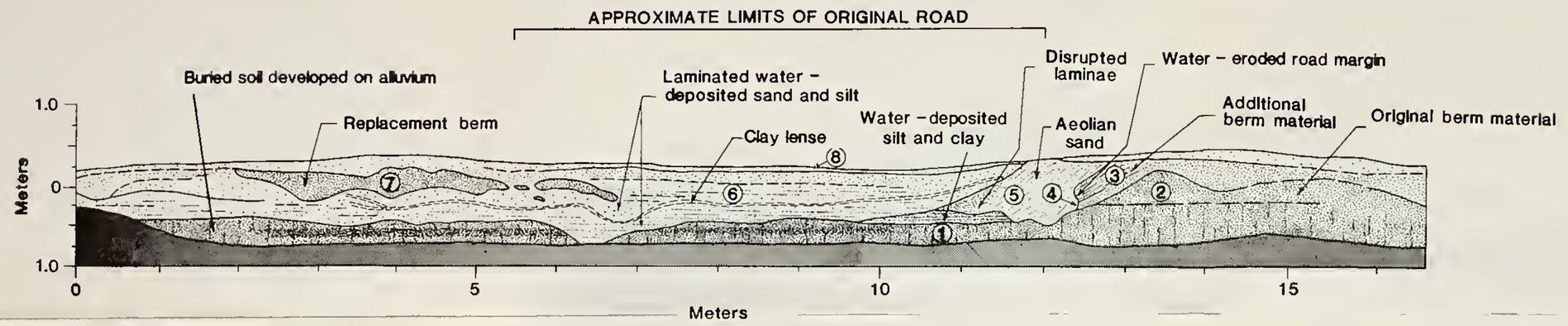
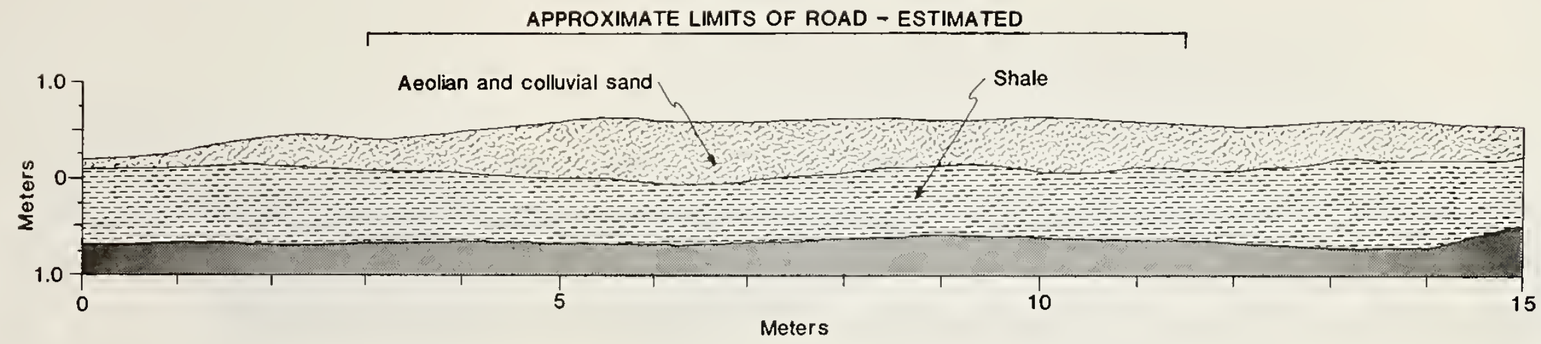
Figure 6-19

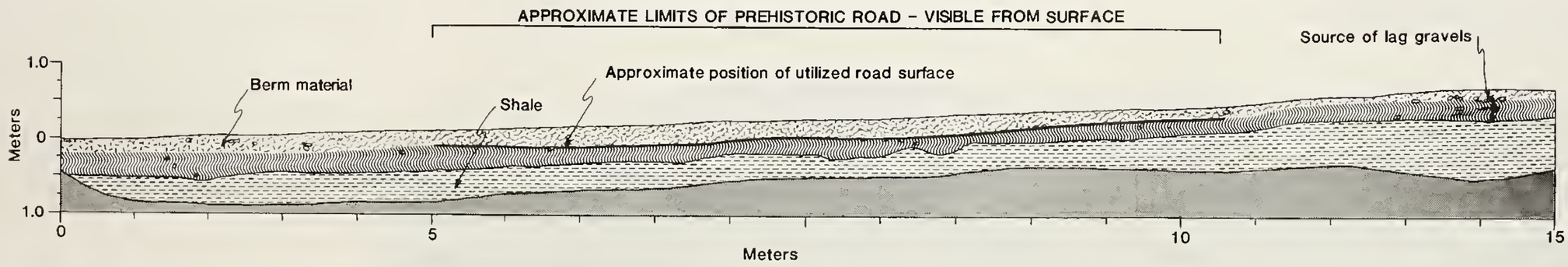
CROSS-SECTION PROFILES OF TRENCHES DUG ACROSS PREHISTORIC AND HISTORIC ROADS, SAN JUAN BASIN, NEW MEXICO.



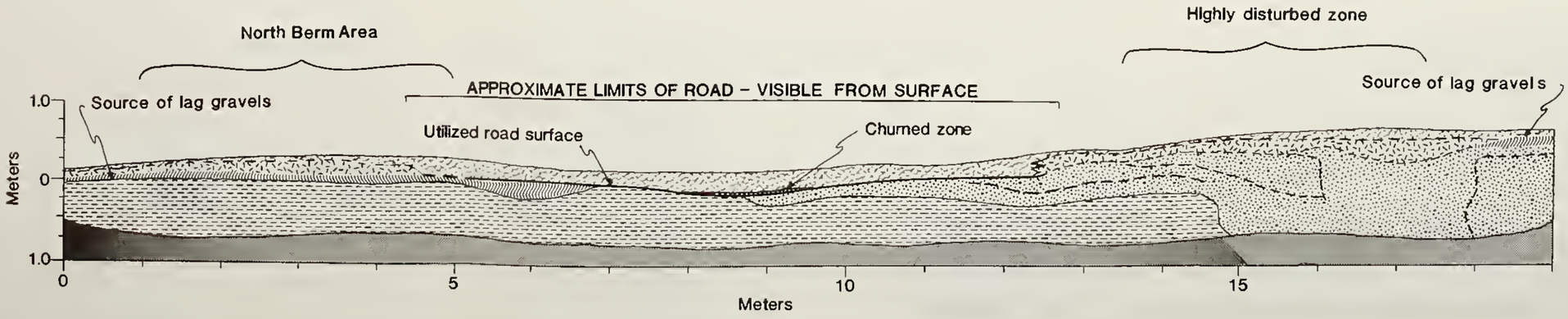
A TRENCH I, SOUTH WALL PROFILE



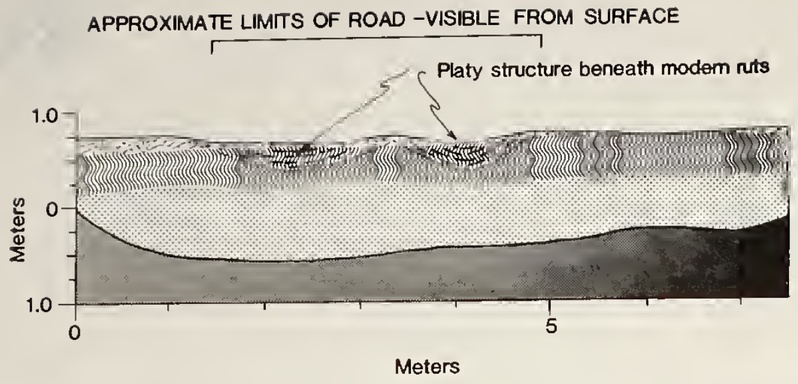
B TRENCH 2, SOUTH WALL PROFILE



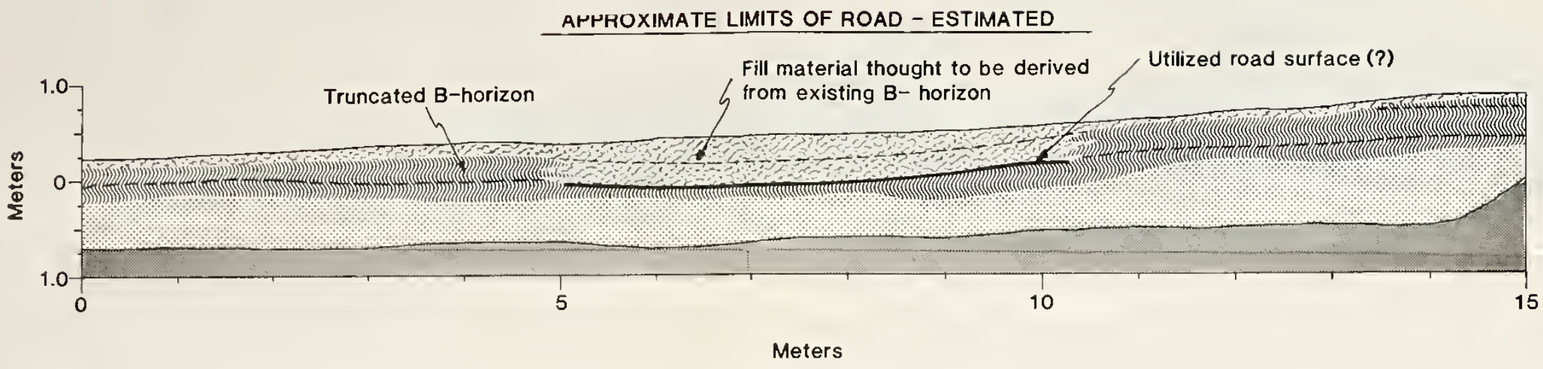
C TRENCH 6, EAST WALL PROFILE



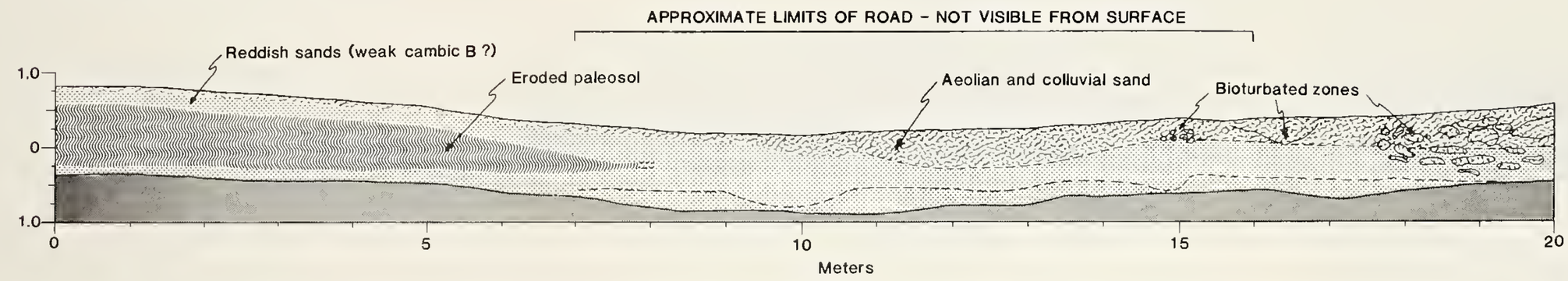
D TRENCH 7, EAST WALL PROFILE



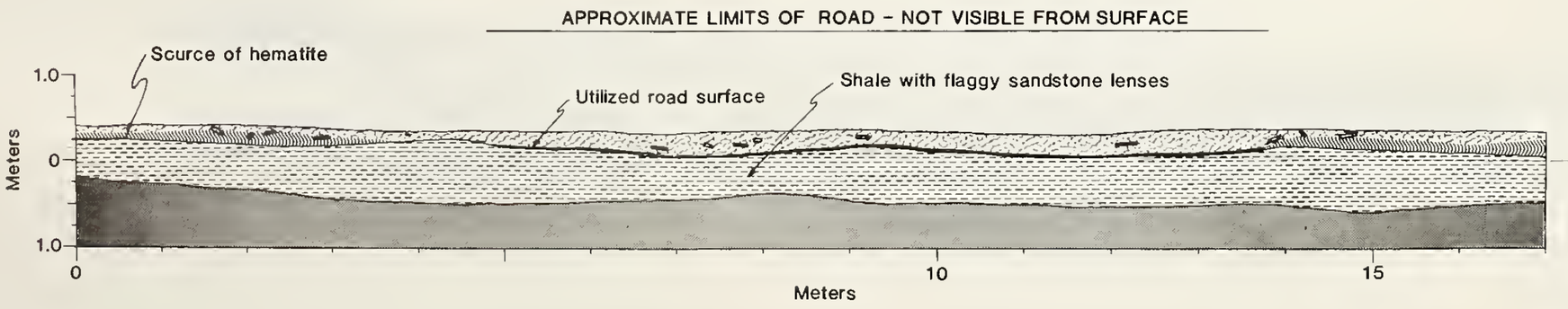
E TRENCH 8, WEST WALL PROFILE



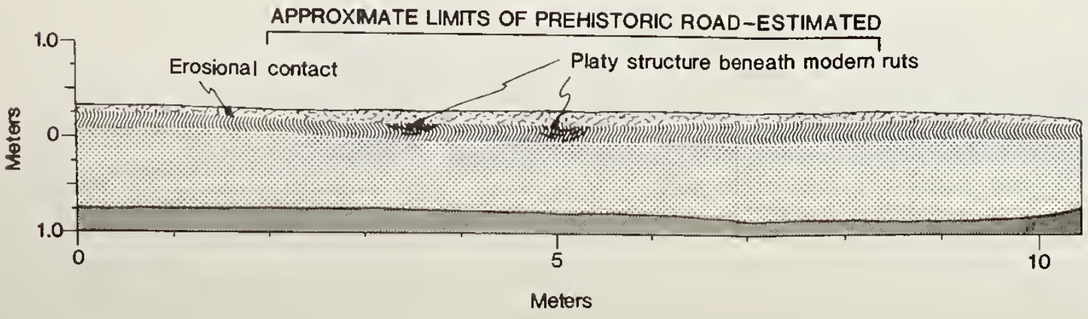
F TRENCH 10, NORTH WALL PROFILE



G TRENCH 11, SOUTH WALL PROFILE



H TRENCH 12, NORTH WALL PROFILE



I TRENCH 13, SOUTH WALL PROFILE

EXPLANATION

- Post - abandonment sediments or soil
- Material excavated from road prior to or during utilization of road
- B-horizon or buried soil
- Gravel
- Sand
- Bedrock
- Not observed
- Depositional or erosional contact
- Approximate location of contact

RECENT ADDITIONS

ER'S CARD 2 - R55

32 1983

project, Phase 1

	OFFICE	DATE RETURNED
801-789-1362		
259-6111	UT-080	JUN 29 '87
1-628-4401	UT-063	JUL 8 '87
	AZ-010	JUL 23 '87

(Continued on reverse)

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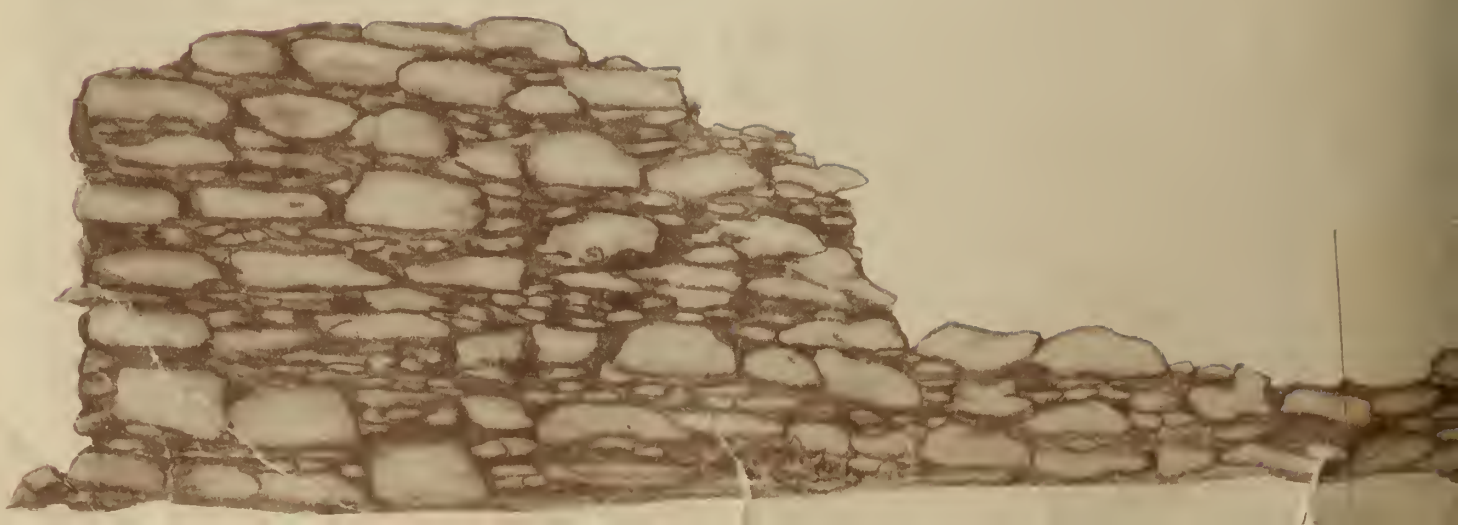
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